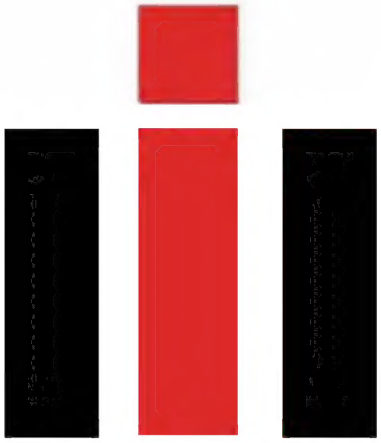


SHOP MANUAL

SERIES:

684 • 784 • 884

Hydro 84

SHOP MANUAL

INTERNATIONAL HARVESTER

SERIES 684-784-884-Hydro 84

Engine serial number is stamped on right side of engine crankcase on all models.
Tractor serial number is stamped on plate attached to right rear side of front axle support.

INDEX (By Starting Paragraph)

INDEX CONT.

CONDENSED SERVICE DATA

	684 Diesel	784 Diesel	Hydro 84 Diesel	884 Diesel
GENERAL				
Engine Make	IH	IH	IH	IH
Engine Model	D-239	D-246	D-246	D-268
Number of Cylinders	4	4	4	4
Bore – Inches	3⅞	3-15/16	3-15/16	3-15/16
Stroke – Inches	5-1/16	5-1/16	5-1/16	5½
Main Bearings, Number of	5	5	5	5
Cylinder Sleeves	Wet	Wet	Wet	Wet
Forward Speeds, Number of	8(1)	8(1)	Infinite	8(1)
Alternator/Starter Make	Bosch, Delco-Remy and Lucas			

(1) Sixteen forward speeds, when equipped with torque amplifier.

TUNE-UP				
Compression Pressure	315-340(2)	315-340(2)	315-340(2)	315-340(2)
Firing Order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Valve Tappet Gap (Hot)				
Intake	0.012 in.	0.012 in.	0.012 in.	0.012 in.
Exhaust	0.012 in.	0.012 in.	0.012 in.	0.012 in.
Valve Seat Angle (Degrees)	45	45	45	45
Injection Pump Make	Robert Bosch			
Injection Pump Timing	16° BTDC	16° BTDC	16° BTDC	16° BTDC
Battery Terminal, Grounded	Negative			
Engine Low Idle – Rpm	700	750	750	750
Engine High Idle – Rpm, No Load	2540	2710	2710	2685
Engine Full Load – Rpm	2300	2400	2400	2400

(2) Approximate psi, at sea level, at cranking speed.

SIZES-CAPACITIES-CLEARANCES				
Crankshaft Main Journal Diameter, Inches	3.1484-3.1492			
Crankpin Diameter, Inches	2.5185-2.5193			
Camshaft Journal Diameter, Inches:				
No. 1 (Front)	2.2823-2.2835			
No. 2	2.2823-2.2835			
No. 3	2.2823-2.2835			
No. 4	2.2823-2.2835			
No. 5	2.2823-2.2835			
Piston Pin Diameter, Inches	1.4172-1.4173			
Valve Stem Diameter				
Intake	0.3919-0.3923 in.			
Exhaust	0.3911-0.3915 in.			
Main Bearing Diametral Clearance	0.0028-0.0055 in.			
Rod Bearing Diametral Clearance	0.0023-0.0048 in.			
Piston Skirt Diametral Clearance	0.0039-0.0047 in.			
Crankshaft End Play	0.006-0.009 in.			
Camshaft Bearing Diametral Clearance	0.0009-0.0033 in.			
Camshaft End Play	0.004-0.018 in.			
Cooling System Capacity – Qts.	14¾	14¾	14¾	14¾
Crankcase Oil – Qts.	9	9	9	9
Transmission and Differential – Gallons	9	9	14½	9

FRONT SYSTEM AXLE TYPE

The front axle assemblies used on all models are the straight adjustable type shown in Fig. 1 and the heavy duty type shown in Fig. 2.

AXLE MAIN MEMBER

All Models

1. To remove the axle main member (10 – Fig. 1 or Fig. 2), raise front of tractor and place supports under engine and clutch. Remove front wheel and hub assemblies, then unbolt and remove axle extension assemblies. Identify and disconnect power steering cylinder hoses. Plug or cap openings to prevent entrance of dirt or other foreign material into system. Remove cylinder rod anchor pin, unbolt pivot bracket (15) and remove steering cylinder. Move steering arm (13) rearward and lower the steering arm and tie rods from axle main member. Support axle main member with a floor jack, remove pivot shaft (11), then lower axle main member from front support (20).

Inspect all parts and renew any showing excessive wear or other damage. Reinstall by reversing the removal procedure. Tighten axle extension shoulder bolts (17) and nuts to a torque of 246-272 ft.-lbs. If necessary, adjust toe-in as in paragraph 2 and bleed air from steering system as in paragraph 12.

TIE RODS AND TOE-IN

All Models

2. The procedure for removal and disassembly of the tie rods is obvious after an examination of the units. Tie rod ends are non-adjustable and faulty units will require renewal.

Adjust toe-in on all models to ⅛-inch plus or minus 1/16-inch. Adjustment is made by varying the length of the tie rods. Both tie rods should be adjusted an equal amount with not more than one turn difference when adjustment is complete.

STEERING KNUCKLES

All Models

3. To remove either steering knuckle (7 – Fig. 1 or Fig. 2), support front of tractor and remove front wheel. Disconnect tie rod from steering arm, loosen clamp bolt and remove steering arm. Remove the Woodruff key and lower

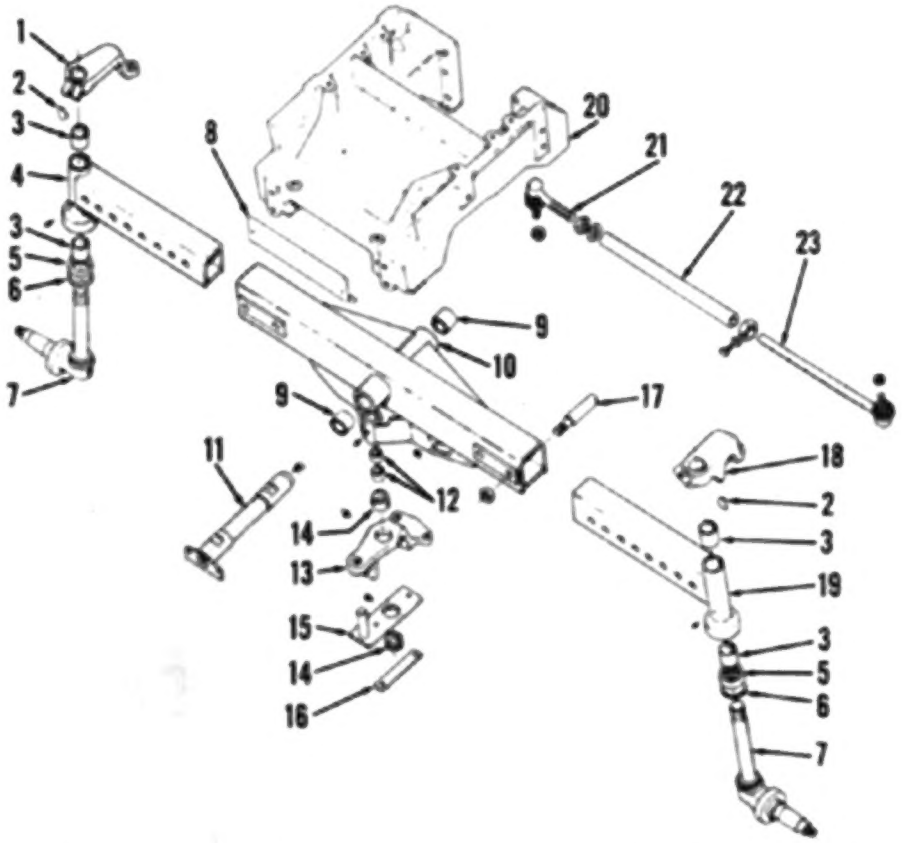


Fig. 1 – Exploded view of straight adjustable front axle assembly available on all models.

1. Steering arm R.H.
2. Woodruff key
3. Bushings
4. Axle extension R.H.
5. Thrust bearing
6. Felt washer
7. Steering knuckle R.H.
8. Front cover
9. Pivot bushings
10. Axle main member
11. Pivot shaft
12. Bushings
13. Center steering arm
14. Bushings
15. Cylinder pivot bracket
16. Lock plate
17. Shoulder bolt (4)
18. Steering arm L.H.
19. Axle extension L.H.
20. Front support
21. Tie rod end (inner)
22. Tube
23. Tie rod end (outer)

Fig. 2 – Exploded view of heavy duty adjustable front axle assembly available on all models. Refer to Fig. 1 for legend.

steering knuckle assembly from axle extension. Remove wheel hub and bearings if necessary.

Inspect all parts and renew as necessary. Bushings (3) are installed with open ends of grooves inward. Install bushings 1/16-inch below flush with edge of bore in axle extension. Install new felt washer (6) on steering knuckle, then install thrust bearing (5) with chamfered side toward the felt washer. Balance of reassembly is the reverse of disassembly procedure. If hub was removed, refer to paragraph 4 for wheel bearing adjustment procedure.

WHEEL HUB AND BEARINGS

All Models

4. Front wheel bearings should be removed, cleaned and repacked with IH251H EP or equivalent No. 2 multipurpose lithium grease each 800 hours of operation. Raise front of tractor and remove cap (10 – Fig. 3), nut (9), washer (8) and outer bearing cone (7). Lift off wheel and hub assembly and remove inner bearing cone (3). Clean and inspect all parts and renew any showing excessive wear or other damage.

Install new wear ring (2) in hub and new seal (1) on steering knuckle as required. Install bearing cups (4 and 6) in hub, if removed. Pack inner bearing cone (3) and install on steering knuckle. Apply a liberal coat of grease to seal and install hub assembly. Pack outer bearing cone (7) and install it on steering knuckle, followed by washer (8) and nut (9). Tighten nut to 70 ft.-lbs. torque while rotating wheel. Back nut off, then retorque to 50 ft.-lbs. Back nut off ¼-turn and install cotter pin. Install cap (10).

Fig. 3 – Exploded view of front wheel hub and bearings.

1. Seal
2. Wear ring
3. Bearing cone (inner)
4. Bearing cup
5. Hub
6. Bearing cup
7. Bearing cone (outer)
8. Washer
9. Nut
10. Cap

FRONT SYSTEM ALL-WHEEL DRIVE

Models 684, 784, 884 and Hydro 84 tractors are available as 4-wheel drive (All-Wheel Drive) units. The front drive axle incorporates a bevel pinion shaft mounted in tapered roller bearings and a differential unit supported with ball bearings, located in the center housing. Stub drive shafts

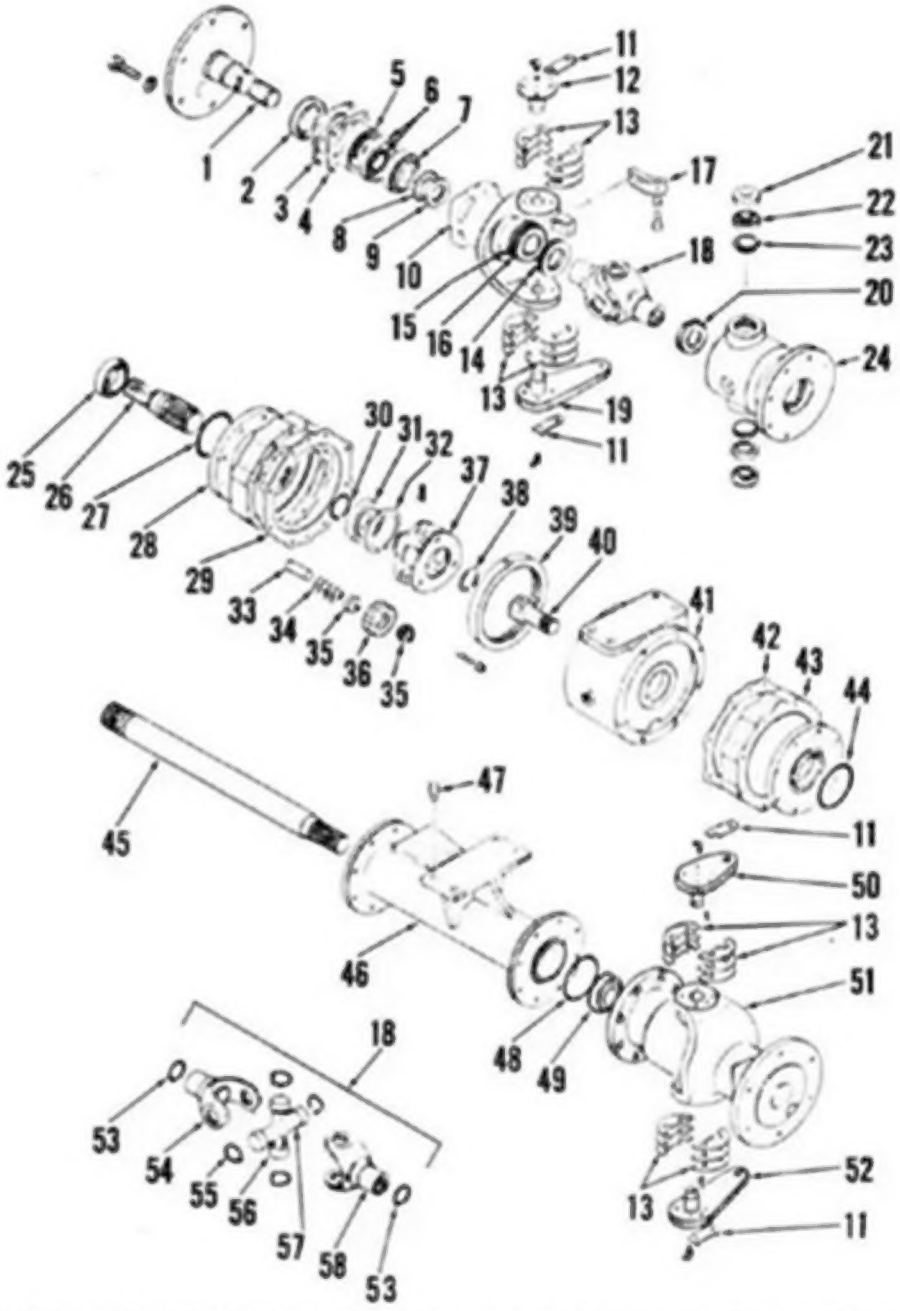


Fig. 4 – Exploded view of front drive axle assembly. Refer to Fig. 5 for center (front differential) section.

1. Outer axle shaft R.H.
2. Seal
3. Retainer
4. Gasket
5. Bearing assy.
6. Spacers (inner & outer)
7. Bearing assy.
8. Lockwasher
9. Nut
10. Swivel housing
11. Lock plate
12. Pivot shaft (upper)
13. Shims (0.002, 0.005, 0.020 & 0.040 in.)
14. Seal
15. Belleville washer
16. Washer
17. Stop bracket
18. Universal joint
19. Steering arm & pivot shaft
20. Seal
21. Seal
22. Bearing assy.
23. Plug
24. Outer axle housing
25. Seal
26. Inner axle shaft R.H.
27. "O" ring
28. Planetary housing R.H.
29. Gasket
30. Snap ring
31. Bearing
32. Snap ring
33. Pin
34. Shims (0.002, 0.005, 0.012 & 0.020 in.)
35. Bearing cone
36. Planet gear
37. Planet carrier
38. Snap ring
39. Ring gear
40. Sun gear (stub shaft)
41. Differential section
42. Gasket
43. Planetary assy. L.H.
44. "O" ring
45. Inner axle shaft L.H.
46. Inner axle housing L.H.
47. Breather
48. "O" ring
49. Bearing assy.
50. Upper (cylinder) steering arm & pivot shaft
51. Steering pivot assy. L.H.
52. Steering arm & pivot shaft (lower)
53. Snap ring
54. Yoke
55. Snap ring
56. Bearing & seal
57. Cross
58. Yoke

splined into the differential gears, drive the planetary reduction drive gear units, located in the planetary housings. Inner axle shafts are mounted in ball bearings and transmit the drive through universal joints to the outer axle shafts. Outer axle shafts are carried in tapered roller bearings in the swivel housings. Swivel housings pivot on two bearings in each outer axle housing.

The drive for the front axle is taken from the tractor range transmission bevel pinion shaft to the transfer case mounted on right side of tractor. The transfer case houses idler gears, drive gear and a multi-plate drive clutch. Two telescoping drive shafts supported in the middle by ball bearings in a pillow block, connect the transfer case to the front drive axle.

It is not necessary to depress the clutch pedal or stop the tractor to engage or disengage the front drive axle.

CAUTION: Tractor should not be driven in high range 3rd or 4th gears with the 4-wheel drive system engaged.

FRONT AXLE ASSEMBLY

All Models So Equipped

5. **REMOVE AND REINSTALL.** To remove the front drive axle assembly, remove front end weights if so equipped, then remove the front support front cover. Block rear wheels securely and loosen front wheel nuts. Support front of tractor so that front wheels just clear the ground. Remove front wheels. Disconnect drive shaft from the axle drive flange. Disconnect steering cylinder hoses and cap or plug openings immediately to prevent entrance of dirt or other foreign material into the system. Using floor jacks or equivalent under axle, unbolt and remove the pivot pin, then lower axle assembly from tractor.

Reinstall the axle assembly by reversing the removal procedure. With assembly completed, operate engine and turn steering wheel from lock to lock at least 12 times to bleed any air from steering system.

OUTER AXLE SHAFT, SWIVEL HOUSING & BEARINGS

All Models So Equipped

6. **R&R AND ADJUST.** Outer ends of front drive axle are similar except for the steering cylinder attached to upper steering arm (50 – Fig. 4) on the left end. Therefore, the following procedure for the right end will also apply to the left end after steering cylinder is removed.

Support front of tractor with a suitable jack under center (differential) section (41) and remove right front wheel. Remove the four cap screws from retainer (3) and withdraw outer axle shaft assembly (1 through 9). Bend back tab of lockwasher (8), then remove nut (9) and lockwasher. Using a suitable puller, remove retainer, spacers and bearing assemblies from outer axle shaft. Clean and inspect all parts and renew any showing excessive wear or other damage.

Before installing bearings on outer axle shaft, measure shim gap (D – Fig. 6) as follows: Stack outer bearing (8 and 9), inner spacer (7), outer spacer (6) and inner bearing (4 and 5) as shown in Fig. 6. Using a feeler gage, measure distance (D) between inner spacer (7) and inner race of bearing (4). Select a shim pack equal to this measurement. Shims are available in thicknesses of 0.002, 0.004, 0.012 and 0.020 inch.

Refer to Fig. 7, pack the 2-piece seal (1 and 2) with grease and press into retainer (3). Install retainer and seal assembly up against shoulder on outer axle shaft. Press cone (9 – Fig. 6) of outer bearing on shaft as far as possible, then install outer bearing cup (8). Press inner bearing cup (5) into outer spacer (6) and position this assembly over shaft against bearing cup (8). Install inner spacer (7) with the selected shim pack. Position inner bearing cone (4) on the shaft and using nut (9 – Fig. 4) without lockwasher (8), force the bearing onto the shaft. Progressively tighten the nut, regularly checking that bearings can be turned, until torque on nut reaches 310-370 ft.-lbs. Push seal retainer away from outer bearing to reduce the seal drag. Wrap a cord around the wheel studs and attach a spring scale to end of

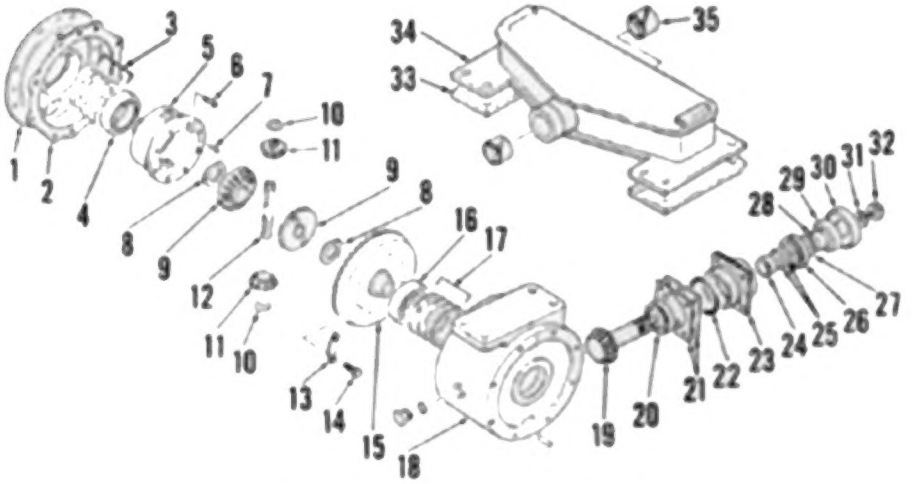


Fig. 5 – Exploded view of center (differential) section of front drive axle.

1. Differential cover R.H.
2. Gasket
3. Shims (0.002, 0.0075, 0.012 & 0.020 in.)
4. Bearing
5. Differential case
6. Dowel screw
7. Dowel pin
8. Thrust washer (0.079 & 0.084 in.)
9. Side gear
10. Thrust washer
11. Pinion gear
12. Differential pinion shaft
13. Lock plate
14. Cap screw
15. Bevel ring gear
16. Bearing
17. Shims (0.002, 0.0075, 0.012 & 0.020 in.)
18. Differential housing
19. Bevel pinion shaft
20. Bearing assy.
21. Shims (0.0075 & 0.020 in.)
22. "O" ring
23. Bearing housing
24. Spacer
25. Shims (0.002 & 0.004 in.)
26. Bearing assy
27. "O" ring
28. Collar
29. Oil seal
30. Cover
31. Washer
32. Slotted nut
33. Spacer
34. Axle carrier
35. Pivot bushings

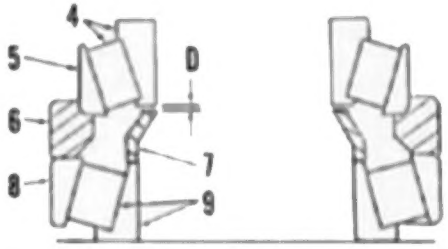


Fig. 6 – Stack outer axle bearings and spacers as shown and measure distance (D) to determine shim pack for bearing adjustment.

4. Inner bearing cone
5. Inner bearing cup
6. Outer spacer
7. Inner spacer
8. Outer bearing cup
9. Outer bearing cone

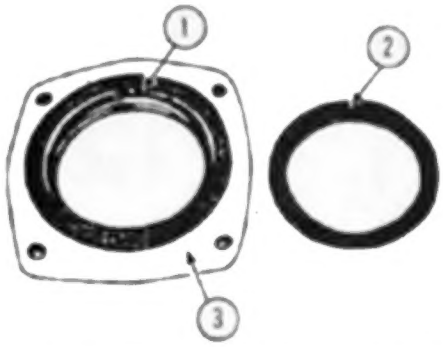


Fig. 7 – View showing 2-piece outer seal (1 and 2) and retainer (3).

cord as shown in Fig. 8. Check amount of pull on scale needed to keep axle shaft rotating. Amount of pull required should be 1 to 8 pounds. If the seal is not held away from the outer bearing, seal drag will increase the amount of pull by about 4 pounds. Add or remove shims as required to correct the bearing adjustment. Remove the nut (2 – Fig. 9), pack cavity between inner and outer spacers with grease and install lockwasher (3). Apply grease to contact faces of nut and lockwasher and tighten nut to a torque of 310-370 ft.-lbs. Bend tab of lockwasher into one of the notches in the nut. Wrap the assembly in clean paper and lay it aside for later installation.

To remove the swivel housing (10 – Fig. 4) and universal joint (18), first disconnect tie rod from steering arm (19). Straighten lock plate (11) and remove cap screws from upper pivot shaft (12). Remove pivot shaft taking care not to lose shims (13). Straighten lower lock plate (11), then unbolt and remove steering arm (19) and shims (13). Lift off swivel housing (10) and remove universal joint (18). Using a hammer and punch through outer end of swivel housing, drive out seal (14), washer (16) and Belleville washer (15).

A repair kit for the universal joint (18), consisting of a new cross (57), bearings with seals (56) and snap rings (55), is available. Disassembly and reassembly procedure of "U" joint is conventional.

Remove seals (21), pivot bearings (22) and plugs (23) from top and bottom of outer axle housing (24). Clean all parts and renew any showing excessive wear or other damage. Install plugs (23), apply Loctite No. 241 to bearing cups, then press cups into the housing. Pack bearing cones with grease and install in cups. Install seals (21).

Install Belleville washer (15), large diameter first, into swivel housing (10), then install grease coated washer (16). Pack the 2-piece seal (14) with grease and install seal flush in housing. Insert the "U" joint into seal and push "U" joint fully into housing. "U" joint will position seal to correct depth in housing. Carefully withdraw the "U" joint with inner section of seal (14) attached and install "U" joint in the axle housing (24).

Using new gasket (4), install outer axle assembly into swivel housing (10). Tighten retainer cap screws to a torque of 18 ft.-lbs. Install the swivel housing, aligning the "U" joint on the outer axle shaft. Install pivot shaft (12) and steering arm and pivot shaft (19) with lock plates (11), but without shims (13). Tighten cap screws in upper pivot shaft (12) until pivot shaft plate is tight against swivel housing. Tighten cap screws in steering arm and pivot shaft (19) evenly while moving swivel housing back and forth. Hook a spring scale in wheel mounting hole in outer axle hub. Tap the swivel housing with a plastic mallet to seat the pivot bearings. Check the amount of pull on spring scale required to move the swivel housing. Tighten lower cap screws evenly until a pull of 7 to 11 pounds is required to turn housing. Using a feeler gage, measure the gap between steering arm (19) and housing in four places and average the measurements. Select shim pack equal to this average. Shims are available in thicknesses of 0.002, 0.0075, 0.020 and 0.040 inch. Split the shim pack so half is used at top and half at bottom. Tighten the pivot shaft cap screws to a torque of 80 ft.-lbs. Connect tie rod and tighten nut to a torque of 40-50 ft.-lbs. and secure with cotter pin. Install wheel and remove jack. Adjust toe-in if necessary to 5/32 to 13/32-inch.

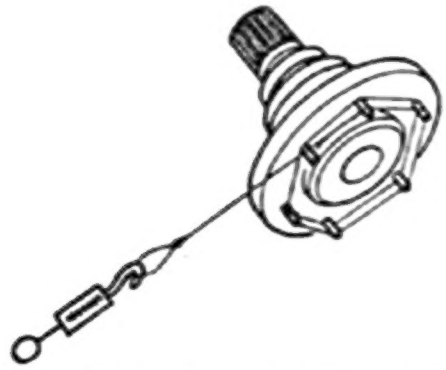


Fig. 8 – Use a cord and spring scale to check pounds pull needed to keep outer axle rotating in bearing assembly. Refer to text.

AXLE HOUSINGS, INNER AXLE AND PLANETARY UNITS

All Models So Equipped

7. **R&R AND OVERHAUL.** Remove the outer axle shaft and swivel housing as an assembly. Drain lubricant from front drive axle. On right side, remove "U" joint (18 – Fig. 4), then unbolt and remove outer axle housing (24), "O" ring (27) and bearing (25). On left side, remove "U" joint, outer axle housing, "O" ring (48) and bearing (49). Unbolt inner axle housing (46) from axle carrier (34 – Fig. 5) and from planetary housing (43 – Fig. 4), then lift off the inner housing. Remove "O" ring (44).

On either side, unbolt and remove planetary units from differential (center) section. The following procedure for the right side will also apply to the left side. Withdraw the sun gear stub shaft (40) from the planetary unit. Remove snap ring (38) from inner end of inner axle shaft (26 or 45) and lift out planet carrier assembly (33 through 37). Press inner axle shaft from inside planetary housing (28) out of bearing (31). Remove snap ring (32), then remove bearing (31) from inside the housing. Straighten tabs on shims (34) and drive roll pins just into pins (33). Press pins out of carrier (37) and remove shims (34) and gears (36) with bearings (35). Drive roll pins from pins (33). If necessary, remove the three spacers, ring gear (39) and the three dowel pins.

Clean and inspect all parts and renew any showing excessive wear or other damage. Lubricate bearings (35) with SAE90 EP gear oil, place bearings in planet gears (36) and install gears in planet carrier (37). Insert shims (34) until maximum planet gear end float is 0.002 inch. Shims are available in thicknesses of 0.002, 0.0075, 0.012 and 0.020 inch. Press pins (33) in place, drive roll pins in flush with surface of planet carrier and bend tabs of shims over the roll pins. Install ring gear (39) in housing and drive in dowel pins and spacers. Press bearing (31) in housing and install snap ring (32). Make certain snap ring (30) is installed on axle shaft (26 or 45) and press axle shaft into bearing (31). Position planet carrier assembly on axle shaft in housing and install snap ring (38) on inner end of axle shaft. Install the sun gear stub shaft (40) in the planetary unit. Using a new gasket (29 or 42), install planetary unit, engaging stub shaft in the differential. Tighten cap screws securing planetary housing to differential housing to a torque of 80 ft.-lbs.

On left side, install new "O" ring (44) and install inner axle housing (46). Tighten attaching bolts to a torque of 80 ft.-lbs. On either side, install bearing (25 or 49) in outer axle housing (24). Pack

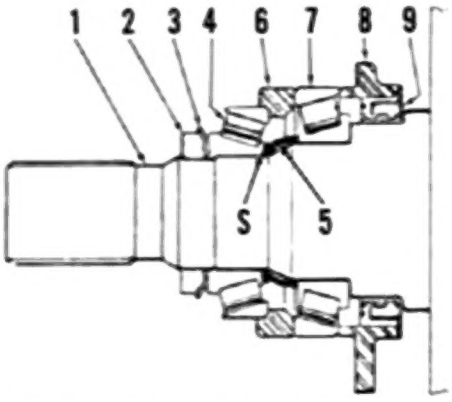


Fig. 9 – View showing bearing assembly installed on outer axle shaft.

1. Outer axle shaft
2. Nut
3. Lockwasher
4. Inner bearing
5. Inner spacer
6. Outer spacer
7. Outer bearing
8. Retainer
9. Seal

the 2-piece seal (20) with grease and install seal flush in housing. Insert "U" joint into seal and push "U" joint fully into housing. "U" joint will position seal to correct depth in housing. Carefully withdraw "U" joint with inner section of the seal attached. Using new "O" ring (27 or 48), install outer axle housing. Tighten attaching bolts to a torque of 80 ft.-lbs. Install "U" joint, then install swivel housing and outer axle assembly. Refer to paragraph 6 and adjust pivot bearings as required. Fill front drive axle to level plug opening with SAE 90 EP gear oil.

BEVEL DRIVE GEARS AND DIFFERENTIAL

All Models So Equipped

8. **R&R AND OVERHAUL.** To remove the differential (center) section (41 – Fig. 4), first remove plug and drain lubricant from front drive axle. Then, remove front drive axle assembly as outlined in paragraph 5. Unbolt and remove axle carrier (34 – Fig. 5) and spacers (33). Disconnect tie rod and unbolt and separate the planetary and axle housing assemblies from the differential housing (41 – Fig. 4).

To disassemble the center section, refer to Fig. 10 and remove the four cap screws (1). Withdraw the bevel drive pinion and bearing assembly, taking care not to lose any shims (2). Remove cover (4) and shims (5), then lift bevel gear and differential assembly and shims (6) from differential housing. Straighten lock plates (1 – Fig. 11), remove cap screws (2) and lift off bevel gear (3). Remove thrust washer (4) and side gear (5). Remove pinion shaft retaining dowel screw (6), push out differential pinion shaft (7) and remove differential pinion gears (8) and thrust washers (9). Lift out side gear (10) and thrust washer (4). Remove bearings (11) from bevel gear and differential case. Clean all differential parts and inspect for excessive wear or other damage. Bushings are renewable in differential pinion gears. Press new bushings (1 – Fig. 12) into pinion gears (2), aligning oil holes, then bend back locating tabs (3). Bevel gear (15 – Fig. 5) and bevel drive pinion (19) are available only as a set.

Apply a coat of petroleum jelly to thick (0.084 in.) thrust washer (8 – Fig. 5) and place it in differential case (5). Install side gear (9), pinion gears (11) with thrust washers (10) and shaft (12). Secure with shaft retaining dowel screw (6). Rotate pinion gears to make sure there is some backlash. If there is no backlash (gear teeth bind), remove the 0.084 inch thick thrust washer and install a 0.079 inch thick thrust washer. Coat a 0.084 inch thick thrust washer with petroleum jelly and place it in bevel gear (15). Install side gear first, then install the differential case assembly on the bevel gear. Rotate pinion gears to make certain there is some backlash; if not, remove the 0.084 inch thick thrust washer and install a 0.079 inch thick thrust washer. Secure bevel gear (15) to case (5) with cap screws (14), tightened to a torque of 45-55 ft.-lbs. and bend locking plates (13) against flats on cap screw heads. Press new bearings (4 and 16) up to the shoulder on case (5) and bevel gear (15). Wrap bevel gear and differential assembly in clean paper and lay aside for later installation.

To disassemble the bevel drive pinion and bearing assembly, refer to Fig. 13 and remove cotter pin, nut (1), washer (2), drive flange (3) and seal cover (4). Press bevel drive pinion (13) from bearing housing (11). Front bearing cone (12), spacer (9) and shims (8) will remain on the drive pinion (13). Note thickness of shims (8) for aid in reassembly, then remove shims, spacer and bearing cone from bevel drive pinion. Remove collar (5) with "O" ring (6), oil seal (10) and rear bearing cone (7) from bearing housing (11). If necessary, remove bearing cups from bearing housing. Clean and inspect all parts and renew any showing excessive wear or other damage. Bevel drive pinion (19 – Fig. 5) is available only as a matched set with bevel gear (15).

Press bearing cone (12 – Fig. 13) on bevel drive pinion (13) until seated against the shoulder, then install spacer (9). If removed, install bearing cups in bearing housing (11) and place bearing housing in position on drive pinion. Install original shim pack (8) or new shims of equal thickness, then install rear bear-

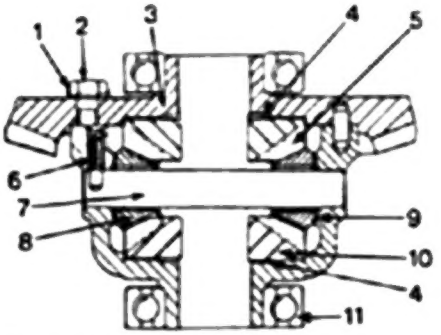


Fig. 11 – Sectional view of bevel gear and differential assembly removed from differential housing.

1. Lock plate
2. Cap screw
3. Bevel gear
4. Thrust washers
5. Side gear
6. Dowel screw
7. Pinion shaft
8. Pinion gears
9. Thrust washers
10. Side gear
11. Ball bearings

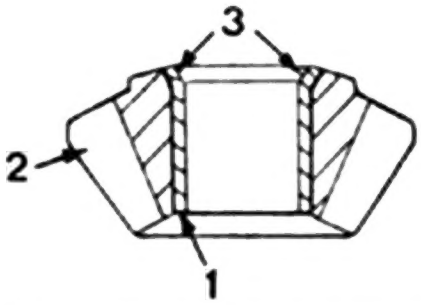


Fig. 12 – Press bushings (1) into pinion gears (2), then bend back locating tabs (3).

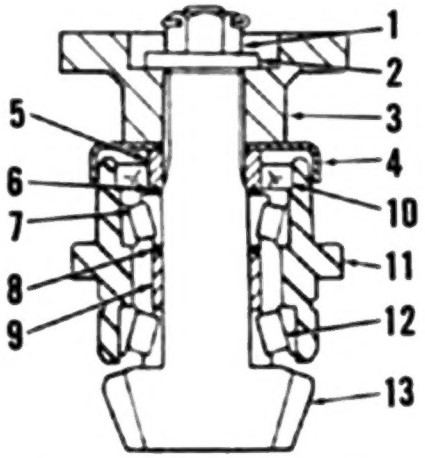


Fig. 13 – Sectional view of bevel drive pinion and bearing assembly.

1. Nut
2. Washer
3. Drive flange
4. Seal cover
5. Collar
6. "O" ring
7. Rear bearing
8. Shims
9. Spacer
10. Oil seal
11. Bearing housing
12. Front bearing
13. Bevel drive pinion

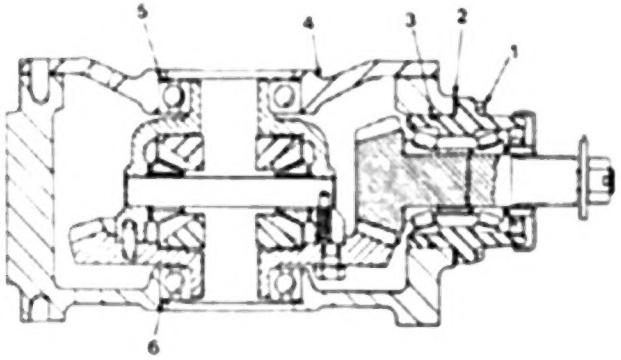


Fig. 10 – Sectional view of bevel drive gears and differential assembly removed from front drive axle.

1. Cap screw
2. Shims
3. "O" ring
4. Cover
5. Shims
6. Shims

ing cone (7). Stand drive pinion in a press and place a heavy wall tube over the shaft against inner race of rear bearing cone. Wrap a cord around bearing housing and attach a spring scale to end of cord. Apply press load on the tube while measuring the amount of pull required on spring scale to keep bearing housing rotating. Bearing preload is correct when 4 to 11 pounds pull is required with a load of 2.5 tons applied on tube. Add or remove shims (8) as necessary until specified pull is obtained.

If a press is not available, install collar (5) without "O" ring (6). Do not install oil seal (10), but install seal cover (4), drive flange (3), washer (2) and nut (1). Wrap a cord around bearing housing and attach a spring scale to end of cord. Progressively tighten the nut while checking the amount of pull on scale needed to keep bearing housing rotating. Bearing preload is correct when 4 to 11 pounds pull is required with the nut tightened to a torque of 65 ft.-lbs. Add or remove shims (8) as necessary until specified pull is obtained.

With the correct bearing preload shims (8) installed, place bearing cone (7) in position against the shims. Install collar (5) with new "O" ring (6) against bearing cone. Install oil seal (10), seal cover (4), drive flange (3), washer (2) and nut (1). Tighten nut to 65 ft.-lbs. torque and secure with cotter pin.

To determine thickness of shim pack (21 – Fig. 5) used in setting drive pinion mounting distance, refer to the following steps and typical examples. Metric system is used in marking the bevel drive pinion; therefore, all measurements used in setting drive pinion mounting distance will be given in millimeters.

Step A. The nominal pinion cone mounting distance (A – Fig. 14) is 110.0 mm. Any variation from this nominal distance is stamped on front face of pinion and will be preceded by a + or –. Add or subtract this figure to the nominal distance to determine the actual mounting distance.

Nominal mounting distance	110.0 mm
Figure-stamped on pinion face	+ 0.10 mm
Actual pinion mounting distance (A)	110.10 mm

Step B. Stand the face of bevel drive pinion on a flat surface, then measure distance (B – Fig. 14) from bearing housing mounting face to the pinion face. Record this measurement.

Bearing housing height (typical)	63.19 mm

Step C. The nominal machined tooth length of bevel drive pinion (C – Fig. 14) is 30 mm. Any variation from this nominal length is stamped on face of pinion and is enclosed in brackets. The stamped figure is in steps of a hundredth millimeter. Add or subtract this figure to the nominal tooth length to determine the actual tooth length.

Nominal tooth length	30.0 mm
Stamped figure (–1)	– 0.01 mm
Actual tooth length (C)	29.99 mm

Step D. To determine the bearing housing mounting distance (D – Fig. 16), add actual pinion mounting distance (Step A) to measured bearing housing height (Step B). Then, subtract actual pinion tooth length (Step C).

Actual pinion mounting distance	110.10 mm
Bearing housing height	+ 63.19 mm
(A + B)	173.29 mm
Actual pinion tooth length (C)	– 29.99 mm
Bearing housing mounting distance (D)	143.30 mm

Step E. Position the pinion setting tool IH No. 9597B in carrier bearing bores of differential housing. Using a depth micrometer, measure distance from pinion mounting face to outside diameter of setting tool (T – Fig. 15). Then, add half the diameter of the setting tool (figure stamped on tool) to the measured distance to determine distance (E – Fig. 15 or 16) from face of differential housing to center line of the carrier bearing bores.

Housing face to setting tool	96.632 mm
Half tool diameter	+ 44.99 mm
Housing face to bearing bore center line (E)	141.622 mm

Step F. To determine the shim pack thickness (F – Fig. 16) required for correct installation of bevel drive pinion, subtract dimension (E) from dimension (D).

Bearing housing mounting distance (D)	143.30 mm
Housing face to bearing bore center line (E)	– 141.622mm
Shim pack required (F)	1.678mm

Shims are available in thicknesses of 0.2 and 0.5 mm. Install new "O" ring (22 – Fig. 5) in groove on bearing hous-

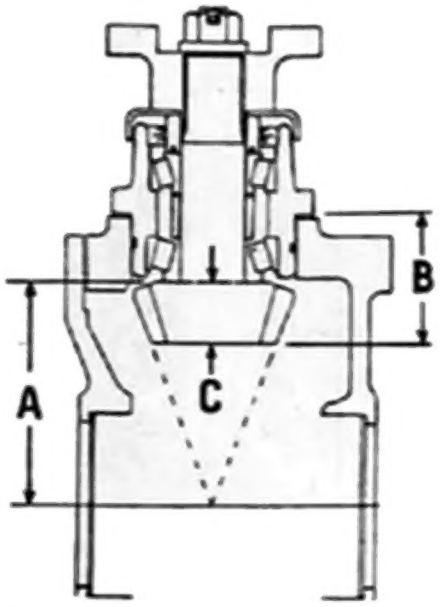


Fig. 14 – Sectional view of bevel drive pinion assembly installed in differential housing. Measurements A, B and C are used when determining pinion setting. Refer to text.

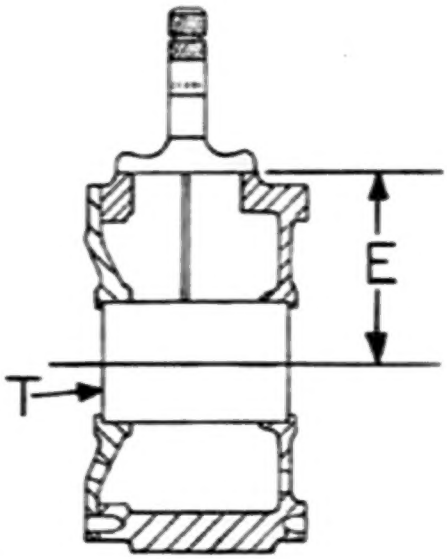


Fig. 15 – Use depth micrometer to measure distance from face housing to special tool (T). Tool (T) is IH No. 95-97B. Refer to text.

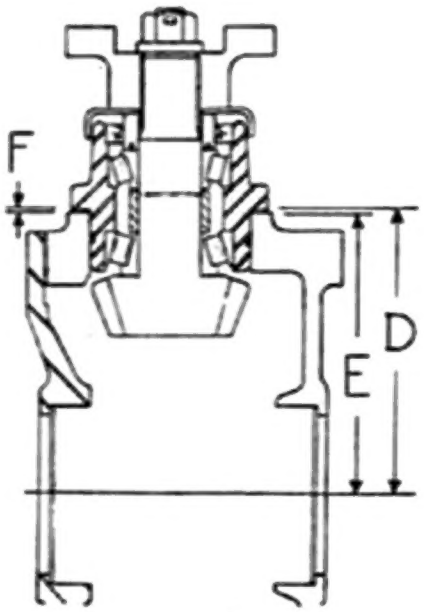


Fig. 16 – To determine thickness of shim pack (F), subtract dimension (E) from dimension (D). Refer to text.

ing (23). Lay bevel drive pinion assembly aside.

To adjust the bevel gear backlash, lay differential housing on its left side and place a selected shim pack (6 – Fig. 10) of approximately 0.055 inch thickness in bearing bore. Install bevel gear and differential assembly, then install bevel drive pinion assembly with the previously determined shim pack (2). Secure with cap screws (1). Mount a dial indicator on the differential housing so the actuator tip of indicator is against bevel gear tooth as close to the outside as possible. Hold bevel pinion stationary and rock bevel gear back and forth, noting indicator reading. Rotate bevel gear and recheck backlash every 90 degrees. Backlash should be 0.004-0.008 inch. If not, add or remove shims (6) as necessary to correct the backlash. Removing shims will increase backlash.

Paint both sides of some bevel gear teeth with yellow ochre or red lead. Rotate pinion until it is in mesh with the painted teeth and a good impression of tooth contact is obtained. Tooth contact pattern on bevel gear should be the same as shown in Fig. 17. If necessary, add or remove shims (6 – Fig. 10) under bevel gear bearing to raise or lower tooth contact pattern. To move tooth contact pattern toward the heel (outer end) or toe (inner end) add or remove shims (2) to move pinion in or out.

Install differential housing cover (4 – Fig. 10) with new gasket, but without shims (5). Using a feeler gage, measure gap between right carrier bearing and cover. Select a shim pack equal to the measured gap plus 0.004 inch. Install shim pack between right carrier bearing and the differential cover.

Using new gaskets (29 and 42 – Fig. 4), install the planetary and axle housing assemblies. Tighten attaching cap screws to a torque of 80 ft.-lbs. Install axle carrier (34 – Fig. 5) and spacers (33), then install front drive axle assembly. Fill front drive axle to level plug opening with SAE 90 EP gear oil.

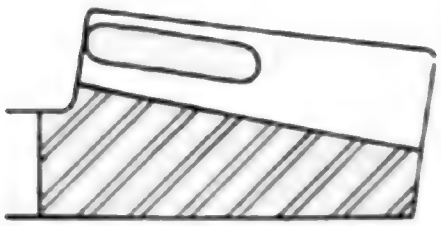


Fig. 17 – View showing correct tooth contact pattern on bevel gear. Refer to text.

FRONT DRIVE CLUTCH & TRANSFER CASE

All Models So Equipped

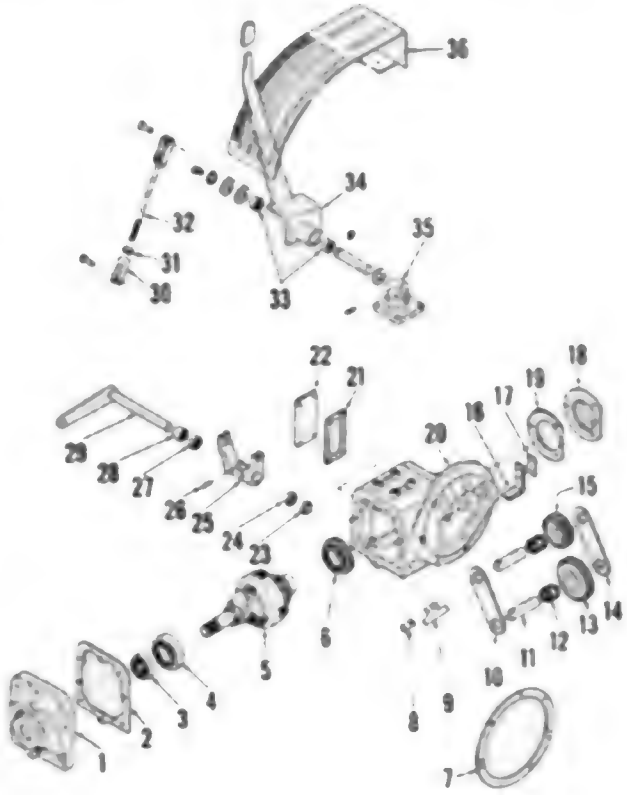
9. **R&R AND OVERHAUL.** To remove the front drive clutch assembly, first drain the oil from the range transmission housing. Loosen the locknut and set screw, then separate rear telescoping drive shaft from clutch output shaft. Refer to Fig. 18 and disconnect clevis (30) from arm on shaft (29). Unbolt and remove front cover (1) with gasket (2) and oil seal (3). Drive out roll pins (26), slide shaft out side of housing (20) and remove fork (25). Unbolt and remove side cover (22) with gasket (21) and rear cover (18) with gasket (19). Wire across the tabs of clutch back plate and return plate to hold clutch pack together. Straighten lockwasher (29 – Fig. 19), then remove cap screw (30), lockwasher and plate (28). Drive clutch assembly (5 – Fig. 18) forward out of rear bearing (6) and remove through front opening of housing.

Using a suitable puller, remove front bearing (4). Remove snap ring (1 – Fig. 19) and washer (2). Remove pins and disconnect three actuator links (9) from clutch sleeve (8), then slide clutch sleeve and release bearing assembly from shaft. Remove snap rings (3 and 4) and separate thrust washers (5), thrust bearing (6), bearing retainer (7) and clutch sleeve. Unscrew and remove adjusting ring (10). Remove outer thrust washer (27), clutch gear and hub (23) and inner thrust washer (17). Remove snap ring (26) and Belleville washers (25) from clutch gear and hub. Remove the clutch and place assembly on a bench. Remove the retaining wires and lift off clutch cup (14). Remove return plate (18), clutch discs (19) and clutch plates (20), then remove return springs (21) from back plate (22).

Clean and inspect all parts and renew any showing excessive wear or other damage. Press new bushing (24) in clutch gear and hub (23), if necessary. New clutch plates (20) and discs (19) must be pre-soaked in I.H. "Hy-Tran" fluid for approximately three minutes before installation. Place return springs (21) on back plate (22), then install a clutch disc (19) followed by a clutch plate (20). When five plates and six discs are stacked, install return plate (18). Position clutch cup (14) over the clutch stack. Make sure snap ring (13) is in position on shaft (15), then install clutch cup and plate assembly on shaft. Install Belleville washers (25) on clutch gear and hub (23) and secure in place with snap ring (26). Install inner thrust washer (17) over shaft, then install clutch gear and hub assembly, locating the splines in clutch discs. Install outer thrust washer (27) so chamfer will face rear bearing. Install a piece of 1.5 inch heavy wall tubing, 0.880 inch long for a spacer, then install plate (28) and cap screw (30) to hold the unit together. If removed, install rollers (11), over center

Fig. 18 – Exploded view of transfer case assembly and clutch control linkage.

1. Front cover
2. Gasket
3. Oil seal
4. Bearing
5. Clutch assy
6. Bearing
7. Gasket (0.014, 0.032 & 0.060 in.)
8. Lock plate
9. Stop plate
10. Thrust plate
11. Idler shaft
12. Needle bearing
13. Idler gear (27T)
14. Thrust plate
15. Idler gear (19T)
16. Pto brake stop
17. Lock plate
18. Rear cover
19. Gasket
20. Housing
21. Gasket
22. Side cover
23. Plug
24. Needle bearing
25. Clutch shift fork
26. Roll pin (2)
27. Needle bearing
28. Oil seal
29. Shaft
30. Clevis
31. Jam nut
32. Link
33. Needle bearings
34. Control lever
35. Bracket
36. Console R.H.



cams (12) and actuator links (9) on adjusting ring (10). Screw adjusting ring assembly on shaft until rollers just contact the clutch cup. Lubricate the thrust bearing (6), then install bearing retainer (7), thrust washer (5), thrust bearing (6) and second thrust washer (5) on clutch sleeve (8) and secure in place with snap rings (3 and 4). Install clutch sleeve assembly and connect actuating links (9) to clutch sleeve.

Adjust the clutch as follows: Refer to Fig. 20 and make sure cap screw (1) is tight. With clutch in disengaged (5) position, measure distance (A). Then, with clutch in engaged (4) position, again measure distance (A). The difference between the two measurements must be within the range of 0.090 to 0.106 inch. If necessary to adjust the clutch, move clutch sleeve (8 – Fig. 19) far enough on shaft to clear the splines. Rotate adjusting ring and clutch sleeve assembly clockwise to increase the difference in measurements or counter-clockwise to decrease the difference. One spline tooth movement changes the difference about 0.0025 inch.

With clutch adjusted, install washer (2) and snap ring (1). Press front bearing (4 – Fig. 18) on shaft until up against the snap ring. Wrap clutch assembly in clean paper and lay aside for later installation.

Remove the transfer case as follows: Unbolt and remove lever bracket (35 – Fig. 18) from top of housing. Remove five external cap screws and two internal cap screws and lift transfer case assembly from tractor. Straighten lock plate (8), remove the two retaining cap screws, lock plate and stop plate (9). Remove shafts (11), gears (13 and 15) and thrust plates (10 and 14). Press rear bearing (6) from housing. Remove oil seal (28) from right side of housing, plug (23) from left side and needle bearings (24 and 27) from both sides. Remove oil seal (3) from front cover.

Clean and inspect all parts and renew any showing excessive wear or other damage. Needle bearings (12) are renewable in gears (13 and 15). If removed, install pto brake stop (16), lock plate (17) and tighten cap screws to 18 ft.-lbs. torque. Press needle bearing (24) in from left side of housing until it is 5/16-inch below flush. Coat plug (23) with a suitable sealant and install it in left side of housing. Press needle bearing (27) in from right side of housing until it is ⅝-inch below flush, then install oil seal (28) in right side of housing. Install idler gears (13 and 15) with needle bearings (12), thrust plates (10 and 14) and shafts (11). Align slots on shafts and secure with stop plate (9), lock plate (8) and cap screws tightened to a torque of 18 ft.-lbs. Bend tabs of lock plates (8 and 17) against flats of cap screw heads.

Measure backlash between idler gears (13 and 15). Using a 0.032 inch thick gasket (7), install transfer case on tractor, making sure tang on pto brake (1 – Fig. 21) is between stop (2) in range transmission housing and stop (3) on the transfer case. Tighten the seven attaching cap screws to a torque of 35 ft.-lbs. Apply the transmission park

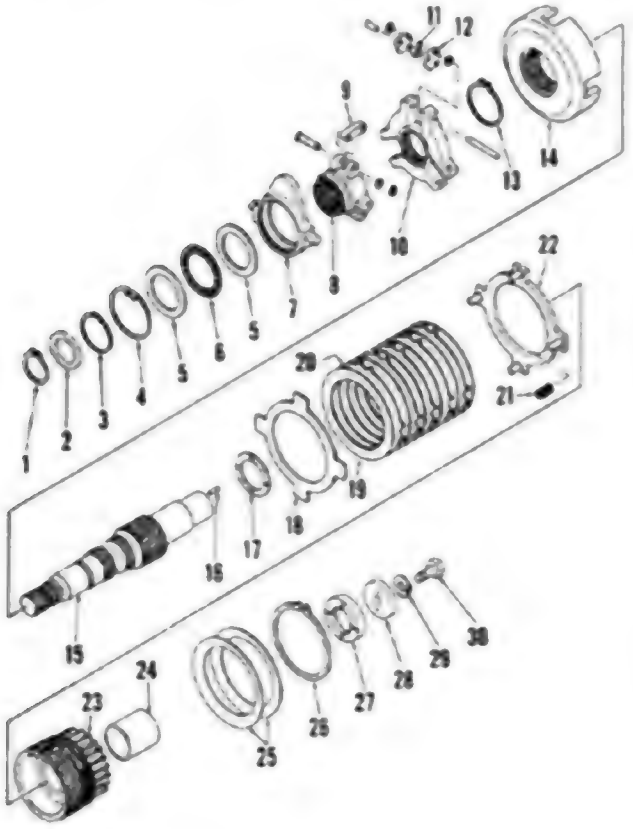


Fig. 19 – Exploded view of multi-plate clutch assembly.

1. Snap ring
2. Washer
3. Snap ring
4. Snap ring
5. Thrust washers
6. Thrust bearing
7. Retainer bearing retainer
8. Clutch sleeve
9. Actuator link (3)
10. Adjusting ring
11. Roller
12. Over center cam
13. Snap ring
14. Clutch cup
15. Output shaft
16. Dowel pin
17. Thrust washer
18. Return plate
19. Clutch disc (6)
20. Clutch plate (5)
21. Return spring
22. Back plate
23. Gear & hub
24. Bushing
25. Belleville washers
26. Snap ring
27. Thrust washer
28. Plate
29. Lockwasher
30. Cap screw

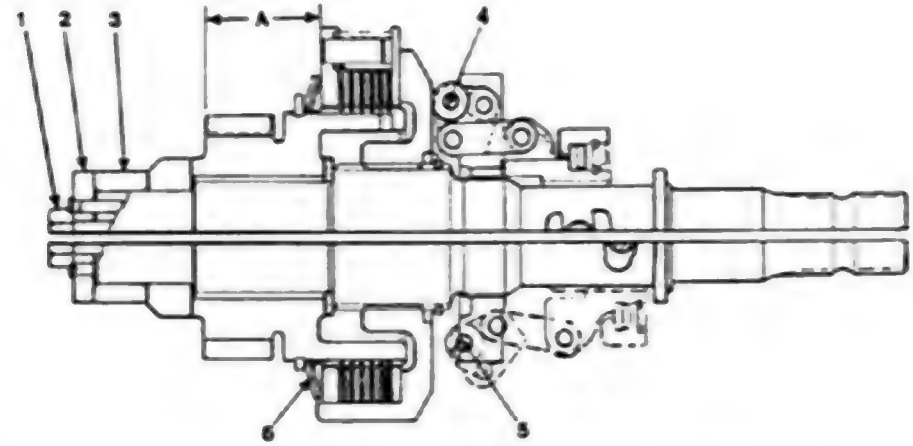


Fig. 20 – Sectional view of front drive clutch assembly in engaged (top) and disengaged (bottom) positions. Refer to text for adjustment procedure.

1. Cap screw
2. Plate
3. Spacer
4. Engaged position
5. Disengaged position
6. Belleville washers

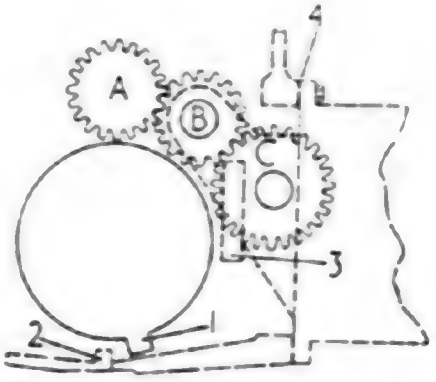


Fig. 21 – Drawing showing mainshaft gear (A) and transfer case idler gears (B and C).

1. Pto brake tang
2. Stop in range housing
3. Stop on transfer case
4. Gasket

brake to lock the transmission main shaft and gear (A). With dial indicator set on gear (C), check maximum backlash obtainable between gears (A, B, and C). From this figure subtract the previously measured backlash between gears (B and C) to determine backlash between gear (A) and idler gear (B). If backlash between gears (A and B) is less than 0.005 inch, install a thicker gasket. If it is more than 0.012 inch, install a thinner gasket. Gaskets are available in thicknesses of 0.016, 0.032 and 0.040 inch.

Install lever bracket (35 – Fig. 18). Wire across tabs of clutch back plate and return plate to keep the clutch plates together, then install clutch assembly in the housing. Remove cap screw (30 – Fig. 19), plate (28) and the tubing spacer. Place bearing (6 – Fig. 18) on rear of shaft and using plate (28 – Fig. 19) and cap screw (30), pull bearing on the shaft and into housing. Remove cap screw, install lockwasher (29), then tighten cap screw to a torque of 65 ft.-lbs. Bend over lock tab on washer. Install clutch fork (25 – Fig. 18), insert shaft (29) and secure with roll pins (26). Install new oil seal (3) in front cover (1) so lip will be toward bearing (4). Using new gasket (2), install front cover and tighten cap screws to 33 ft.-lbs. torque. Install rear cover (18) with new gasket (19) and tighten cap screws to 33 ft.-lbs. torque. Connect clevis (30) to arm on clutch shaft (29). Remove wires retaining clutch plates. Using new gasket (21), bolt side cover (22) in place. Connect rear telescoping drive shaft "U" joint to the clutch output shaft and secure with set screw and locknut.

Fill transmission system with I.H. "HyTran" fluid.

TELESCOPING DRIVE SHAFTS AND PILLOW BLOCK

All Models So Equipped

10. **R&R AND OVERHAUL.** Unbolt front end of front telescoping drive shaft (3 – Fig. 22) from drive flange (1) on front drive axle. Loosen locknut (5) and set screw (4), then remove front shaft assembly (3). Loosen locknuts (5) and set screws (4) on rear telescoping drive shaft (13) and remove the rear shaft assembly. Unbolt and remove pillow block assembly from bracket (8). Remove the three through bolts and remove side covers (6 and 11). Press shaft (12) and bearing (7) out of pillow block (9), then press shaft out of bearing. Press bearing (10) out of pillow block. Clean and inspect bearings and pillow block and reassemble as follows: Install bearing (10) in pillow block (9) so that sealed side of bearing is toward outside. From opposite side of pillow block, press shaft (12) into bearing (10) up to the shoulder. Fill pillow block with No. 2 lithium grease, then press bearing (7) with sealed side outward, onto the shaft and into the pillow block. Install side covers (6 and 11) and secure with through bolts and nuts. Bolt pillow block assembly to bracket (8).

"U" joint cross and bearing sets (2) are available for repair of the telescoping drive shafts (3 and 13) and procedure is conventional. The balance of reassembly is the reverse of disassembly procedure.

HYDROSTATIC STEERING SYSTEM

NOTE: The maintenance of absolute cleanliness of all parts is of utmost importance in the operation and servicing of the hydrostatic steering system. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

STEERING FLUID CIRCUITS

All Models

11. Power steering is standard equipment on all tractors. Refer to Fig. 23 for view showing relative position of power steering components. The 12.5 gpm (Model 684) or 13.0 gpm (Models 784, 884 and Hydro 84) hydraulic pump is mounted on inside of multiple control valve (Fig. 24). Pressurized fluid from

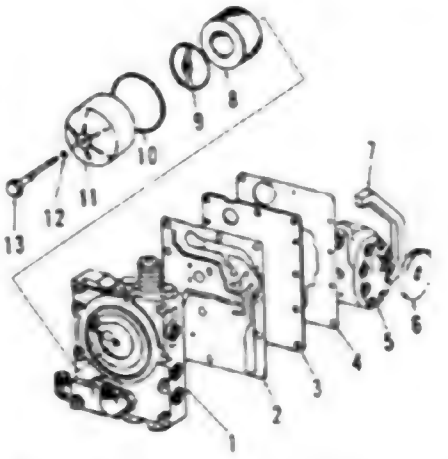


Fig. 24 – Multiple control valve, hydraulic pump and filter located on left side of rear frame on all models.

1. Multiple control valve
2. Gasket
3. Plate
4. Gasket
5. Pump
6. Gear
7. Seal
8. Filter element
9. Filter by-pass valve
10. Gasket
11. Cover
12. "O" ring
13. Bolt

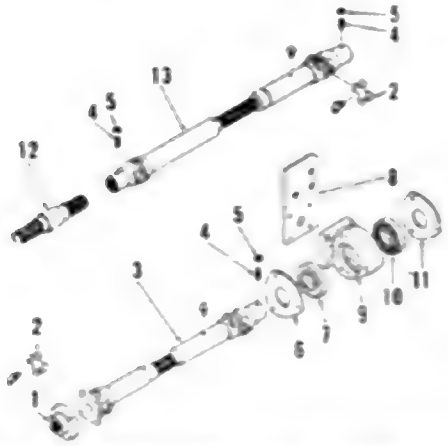
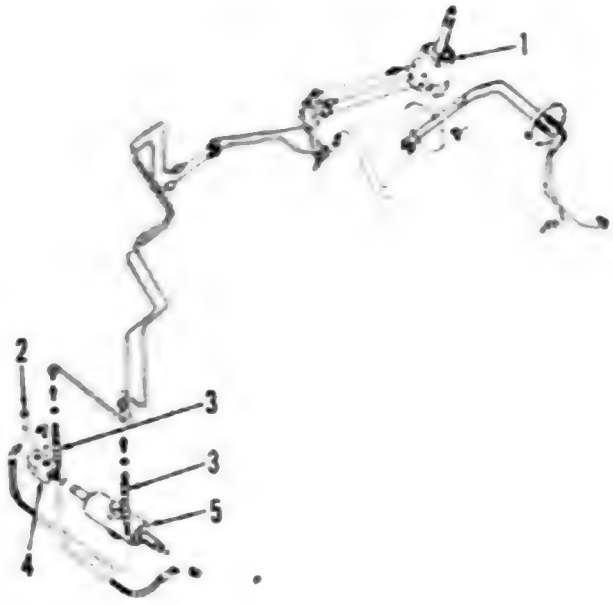


Fig. 22 – Partially exploded view of telescoping drive shafts and pillow block assemblies.

1. Drive flange
2. Cross & bearings assy.
3. Front drive shaft
4. Set screws
5. Locknuts
6. Side plate
7. Front bearing
8. Bracket
9. Pillow block
10. Rear bearing
11. Side plate
12. Shaft
13. Rear drive shaft

Fig. 23 – Schematic view showing general layout of component parts of typical power steering system.

1. Steering control valve (hand pump)
2. Anchor pin
3. Cylinder hoses
4. Clevis
5. Steering cylinder



the pump is fed to a priority flow divider valve. This valve diverts a constant flow of 2.5 gpm through a check valve and into the steering circuit. Return flow from the power steering is returned back to the multiple control valve and is controlled at a lower pressure (220-250 psi) to operate the pto clutch. Excess fluid goes through the oil cooler and is returned to the rear frame. A relief valve in the power steering system limits the pressure in the system to 1500-1600 psi.

The steering control valve meters and directs the 1500-1600 psi fluid to the steering cylinder which supplies the required steering effort according to steering wheel turn. The only effort required at the steering wheel is that which is necessary to overcome the control valve spool centering device.

Manual steering (engine stopped) is accomplished in a similar manner except there is no power assistance. When steering wheel is turned, the metering section now acts as a pump and delivers fluid through the spool to the steering cylinder. Returning fluid from the steering cylinder is directed back to the metering section to complete the circuit.

LUBRICATION AND BLEEDING

All Models

12. The tractor rear frame serves as a common reservoir for all hydraulic and lubrication operations. The filter elements (Fig. 24 and Fig. 25) should be renewed at 10 hours, 100 hours and then every 200 hours of operation thereafter. Hydraulic fluid should be drained and new fluid installed every 800 hours of operation or once a year, whichever occurs first. Only IH "HyTran" fluid should be used and level should be maintained at full mark on dipstick.

Whenever power steering lines have been disconnected or the fluid changed, start engine and cycle power steering system from stop to stop several times. On Model Hydro 84, place range transmission in neutral position and operate the S-R (hydrostatic control) lever from full forward to full reverse several times. With the air bled from the system, check fluid level and add fluid as required.

NOTE: To check the fluid level, operate engine at 1600 rpm for 3 minutes; then check level on Hydro 84 with engine operating and on Models 684, 784 and 884 with engine stopped.

HYDRAULIC FLOW AND PRESSURE TEST

All Models

13. Flow and pressure test can be made using a Flo-Rater or equivalent. Refer to Fig. 26 and connect inlet of Flo-Rater to the pressure outlet of the power steering and hitch. Then, connect outlet of Flo-Rater to the return port from the hitch.

14. HYDRAULIC PUMP. To check the pump free flow operate engine at rated rpm (2300 on Model 684 or 2400 on Models 784, 884 and Hydro 84). Restrict the Flo-Rater to 1250 psi. There should be a 12.5 gpm flow on Model 684 or 13.0 gpm flow on Models 784, 884 and Hydro 84.

If pump free flow is not as specified, remove and service pump as outlined in paragraphs 18 through 20.

15. STEERING RELIEF VALVE. To check the relief valve, restrict the Flo-Rater to 1500-1600 psi. At this point, the

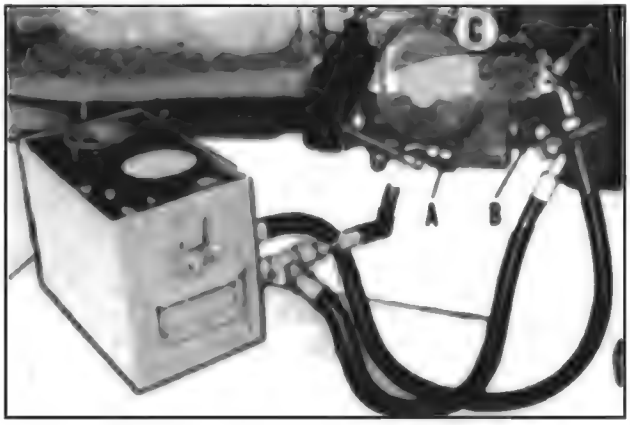


Fig. 26 – View showing Flo-Rater connected for testing hydraulic flow and pressure.
A. Power steering pressure (outlet)
B. Hitch pressure (outlet)
C. Hitch return

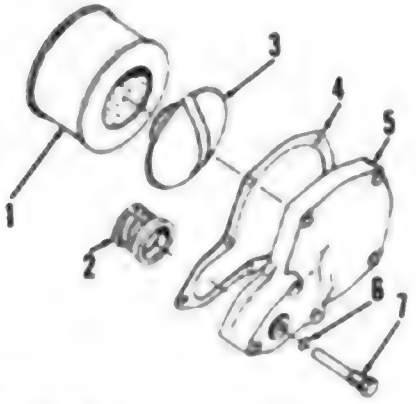


Fig. 25 – On Hydro 84 tractors, a hydrostatic drive filter located on left side of hydrostatic housing is used in addition to filter shown in Fig. 24.
1. Filter element
2. Filter shut-off valve
3. By-pass valve
4. Gasket
5. Cover
6. "O" ring
7. Shut-off valve bolt

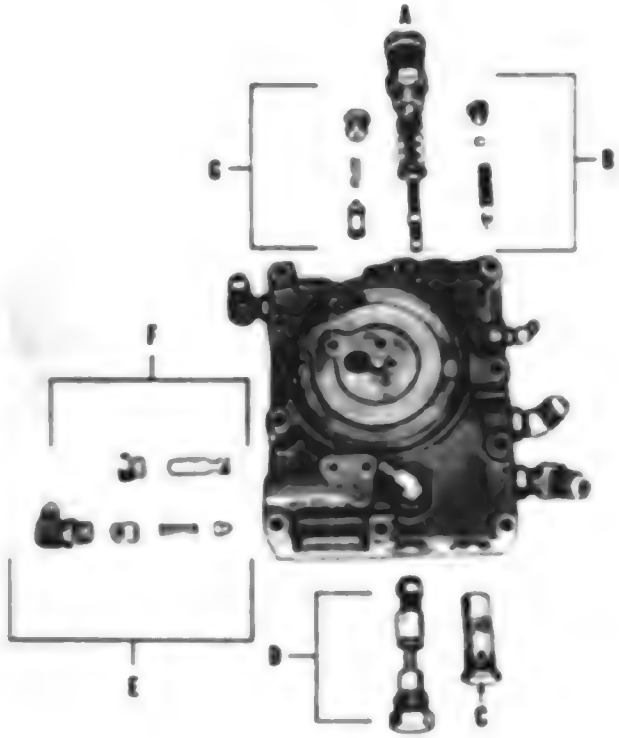


Fig. 27 – Multiple control valve removed and showing control valves removed from their bores.
A. Pto valve
B. Pto pressure regulating valve
C. System relief valve (2500 psi)
D. Flow divider
E. Power steering return check valve
F. Power steering relief valve (1500-1600 psi)
G. Oil cooler by-pass valve

power steering relief valve should open. If pressure is not as specified, renew the relief valve assembly (F – Fig. 27) in the multiple control valve.

16. FLOW DIVIDER. To check the flow divider, restrict the Flo-Rater to 1500-1600 psi. Approximately 2.5 gpm flow loss should occur when relief valve opens. If flow is not as specified, remove the flow divider valve (D – Fig. 27) in the multiple control valve and service by renewing parts.

HYDRAULIC PUMP

All Models

17. Tractors may be equipped with either Cessna (Fig. 28) or Plessey (Fig. 29) gear type pumps. A 12.5 gpm pump is used on Model 684 and a 13.0 gpm pump is used on Models 784, 884 and Hydro 84. A priority type flow divider takes approximately 2.5 gpm for the power steering and the balance is used for the draft and position controls on the hydraulic lift system and for the auxiliary control valves.

18. **REMOVE AND REINSTALL.** To remove the hydraulic pump, drain all compartments of "Hy-Tran" oil and remove hydraulic filter. Disconnect all lines to multiple control valve (MCV) and plug or cap openings. Disconnect pto linkage. Unbolt and remove MCV and pump. Remove cap screws securing pump to MCV.

When reinstalling pump, use new copper sealing washers under the pump mounting cap screws.

Fig. 28 – Exploded view of Cessna hydraulic pump.

1. Pump body
2. Thrust plate
3. Driven gear and shaft
4. Drive gear and shaft
5. Diaphragm
6. Back-up gasket
7. Protector gasket
8. Diaphragm seal
9. "O" ring
10. Seal
11. Cover
12. Ball
13. Spring

19. **OVERHAUL (CESSNA).** With pump removed from MCV, proceed as follows: Remove pump drive gear and key, then unbolt and remove cover (11 – Fig. 28) from body (1). Balance of disassembly will be obvious after an examination of unit.

When reassembling, use new diaphragm, back-up gasket, protector gasket, diaphragm seal, "O" ring and oil seal. With open part of diaphragm seal (8) toward cover (11), work same into grooves of cover using a dull tool. Press protector (7) and back-up gasket (6) into relief of diaphragm seal. Install check ball (12) and spring (13) in cover, then install diaphragm (5) inside the raised lip of diaphragm seal. Make sure bronze face of diaphragm is toward pump gears. Dip gear and shaft assemblies in "Hy-Tran" oil and install them in cover. Position thrust plate (2) in pump body with bronze side toward pump gears and cut-out portion toward inlet (suction) side of pump. Install pump body over gears and shafts and install retaining cap screws. Torque cap screws evenly and alternately to 40 ft.-lbs.

Check pump rotation. Pump will have a slight amount of drag but should turn evenly. Pump gears and shafts, are available only as a pump assembly.

20. **OVERHAUL (PLESSEY).** With pump removed from MCV, proceed as follows: Remove pump drive gear and key, then unbolt and remove covers (1 and 9 – Fig. 29) from body. Balance of disassembly will be obvious after an examination of unit.

With pump disassembled, inspect all parts for scoring, excessive wear or other damage. Use all new seals, backing strips and "O" rings, which are available only in a seal kit. Any other parts are available only as a pump assembly.

Reassemble by reversing the disassembly procedure.

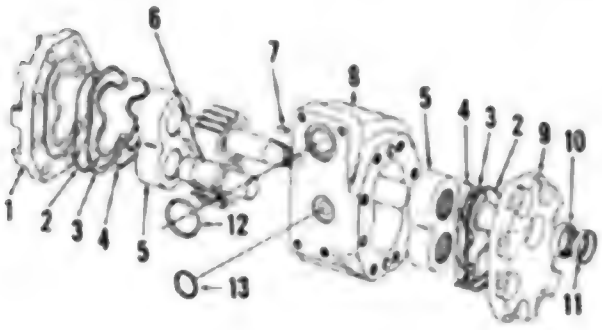


Fig. 29 – Exploded view of Plessey hydraulic pump.

1. Cover
2. Backing strip
3. Seal ring
4. Backing strip
5. Bearings
6. Gear assy.
7. Woodruff key
8. Pump body
9. Cover
10. Seal
11. Seal retainer
12. "O" ring
13. "O" ring

STEERING CONTROL VALVE

All Models

21. **REMOVE AND REINSTALL.** To remove the steering control valve, remove access panel from top of hood, lower side panels from instrument panel, battery and battery tray. Remove steering wheel cap and nut. Using a suitable puller, remove steering wheel. Identify and disconnect the four hydraulic lines from steering valve. Immediately plug or cap all openings to prevent dirt or other foreign material from entering system. Working through opening in instrument panel along side of steering column, remove steering valve mounting bolts and remove the assembly.

Reinstall by reversing the removal procedure, then bleed air from system as outlined in paragraph 12.

22. **OVERHAUL.** Clean exterior of unit and scribe match marks on end plate, rotor plate, distributor plate and valve housing as shown in Fig. 30. Unbolt and remove steering column and shaft (3) from steering valve. Clamp valve housing in a soft jaw vise in inverted position and remove end plate cap screws (25 and 26 – Fig. 31).

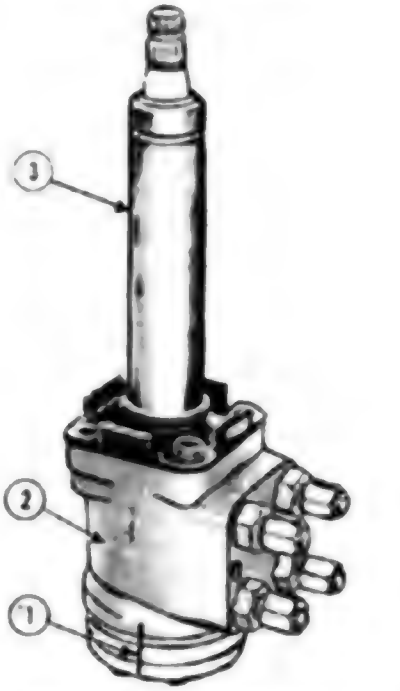


Fig. 30 – View of steering valve (hand pump) used on all models.

1. Match marks
2. Valve housing
3. Steering column and shaft assy.

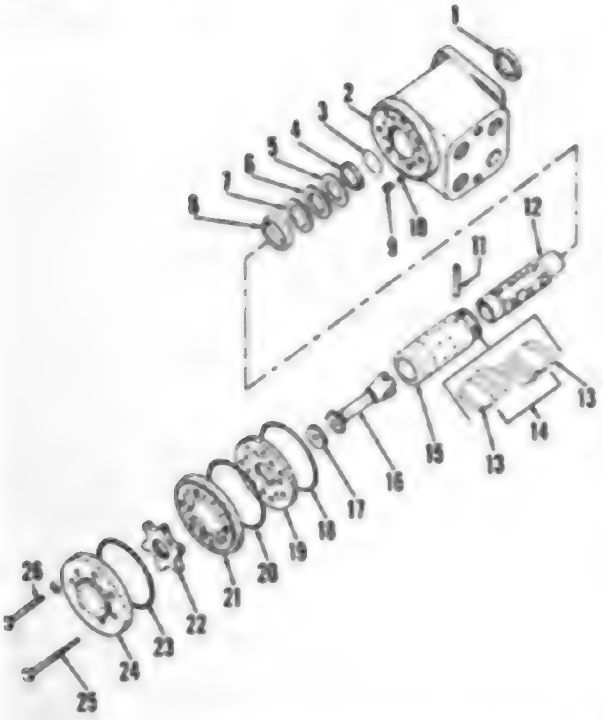


Fig. 31 – Exploded view of steering valve assembly.

1. Oil seal
2. Housing
3. "O" ring
4. Sealing ring
5. Axial washer
6. Needle bearing
7. Bearing race
8. Retaining ring
9. Threaded bushing
10. Check ball
11. Cross pin
12. Spool
13. Outer plate springs (2)
14. Inner plate springs (4)
15. Sleeve
16. Drive shaft
17. Wear washer
18. "O" ring
19. Distributor plate
20. "O" ring
21. Outer ring
22. Inner rotor
23. "O" ring
24. End plate
25. Cap screw w/roll pin
26. Cap screw

NOTE: One cap screw (25) has a roll pin in the end to restrain the check ball (10).

Remove end plate (24), wear washer (17), rotor plate (21) and rotor (22). Remove distributor plate (19) and drive shaft (16), then remove check ball retaining threaded bushing (9) from valve housing and remove check ball (10). Push valve spool assembly from valve housing. Remove axial washer (5), needle (thrust) bearing (6), bearing race (7) and retaining ring (8) from end of spool. Remove cross pin (11) from spool, then slide spool (12) from valve sleeve (15). Remove inner and outer plate springs (13 and 14) from spool. Remove sealing ring (4), "O" ring (3) and oil seal (1) from housing (2).

Clean and inspect all parts and renew any showing excessive wear or other damage. If housing (2), spool (12) or sleeve (15) are not suitable for further service, renew complete assembly as these parts are not serviced separately. All "O" rings and seals are available in a seal kit. Lubricate all internal parts with "Hy-Tran" fluid and coat all "O" rings with vaseline. Reassemble by reversing the disassembly procedure. Install two outer plate springs, then install four inner plate springs as shown in Fig. 32. Use cross-sectional view (Fig. 33) as a guide when reassembling. Align the previously installed match marks and tighten end plate cap screws to a torque of 260-300 in.-lbs. Reinstall steering column and upper shaft assembly.

STEERING CYLINDER

All Models

23. **R&R AND OVERHAUL.** To remove the steering cylinder, identify and disconnect the steering cylinder hoses. Plug or cap the openings to prevent entrance of dirt or other foreign material into the system. On 2-Wheel Drive models, remove cylinder rod anchor pin, unbolt cylinder support arms (center steering arm) and remove cylinder assembly. On "All Wheel Drive" models, unbolt cylinder mounting bracket and disconnect cylinder ball joint from upper steering arm. Remove cylinder, being careful not to lose any shims present under the cylinder.

With cylinder removed, move piston rod back and forth several times to clear oil from cylinder. Place cylinder in a vise and clamp vise only tight enough to prevent cylinder tube from turning. Using a wrench in the flats of piston rod, remove rod clevis (2-Wheel Drive) or ball joint and adapter (All Wheel Drive) from one end and the elbow fitting from opposite end. Lift end of retaining ring (8 – Fig. 34) out of slot, then using a pin type spanner, rotate cylinder head (4) and work retainer ring out of its groove. Cylinder rod and piston assembly (11) and spacers (12), if so equipped, can now be removed from tube (7). Remove remaining cylinder head in the same manner. All seals, "O" rings and back-up washers are now available for inspection and/or renewal. Clean all parts in a suitable solvent and inspect. Check cylinder tube for scoring, grooving and out-of-roundness. Light scoring can be polished out by using a fine emery cloth and oil, providing a rotary motion is used during polishing operation. A cylinder tube that is heavily scored or grooved, or is out-of-round, should be renewed. Check piston rod and piston for scoring, grooving and straightness. Polish out very light scoring with fine emery cloth and oil, using rotary motion. Renew rod and piston assembly if heavily scored or grooved, or if piston rod is bent. Inspect piston seal ring (9) for

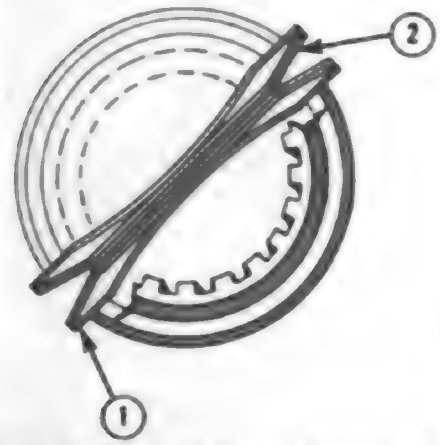


Fig. 32 – View showing correct installation of the two outer plate springs (1) and four inner plate springs (2).

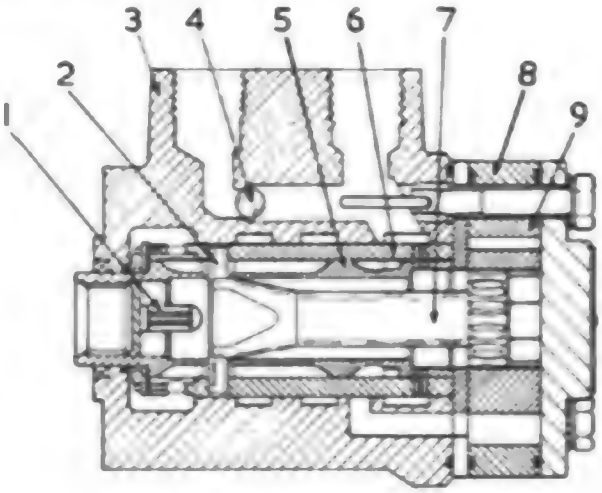


Fig. 33 – Cross-sectional view of Danfoss steering valve used on all models.

1. Plate springs
2. Cross pin
3. Valve body
4. Check ball
5. Spool
6. Sleeve
7. Drive shaft
8. Outer ring
9. Inner rotor

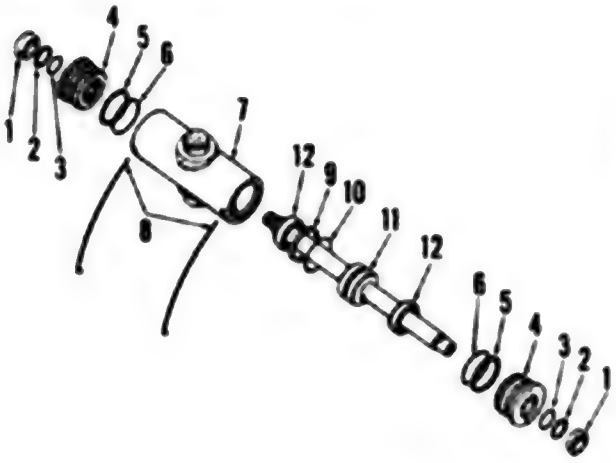


Fig. 34 – Exploded view of steering cylinder assembly. Spacers (12) are used only on All Wheel Drive models.

1 Wiper seal
2 Back-up ring
3 "O" ring
4 Cylinder head
5 Back-up ring
6 "O" ring
7 Cylinder tube
8 Cylinder head retaining rings
9 Piston seal ring
10 "O" ring
11 Piston and rod
12 Spacer (2)

frayed edges, wear and imbedded dirt or foreign particles. Renew piston seal ring if any of the above conditions are found. Inspect balance of "O" rings, back-up washers and seals and renew as necessary. Inspect bores of cylinder heads and renew same if excessively worn or out-of-round.

Reassemble steering cylinder as follows: Install "O" ring (3), back-up washer (2), wiper seal (1), back-up washer (5) and "O" ring (6) in cylinder head, then install cylinder head assembly over externally threaded end of piston rod. Lubricate piston seal ring (9) and cylinder head "O" ring (6). Then, using a ring compressor or a suitable hose clamp around piston seal ring (9), install piston and rod assembly in cylinder tube. Install cylinder head in cylinder tube so hole in groove will accept nib of retaining ring. Position retaining ring and pull same into its groove by rotating cylinder head. Install remaining cylinder head. Install clevis or adapter and ball joint end on piston rod.

Reinstall cylinder assembly on tractor, then bleed air from power steering system as outlined in paragraph 12.

OIL COOLER

All Models

24. Service of the oil cooler involves only removal and reinstallation, or renewal of faulty units. However, since it is hinged on one side, the oil cooler will swing out for cleaning after radiator grille is removed. Removal of oil cooler is obvious after examination of the unit. Inlet and outlet hoses must be identified as they are removed from cooler pipes so oil circuits will be kept in the proper sequence.

DIESEL ENGINE AND COMPONENTS

Model 684 diesel tractors are equipped with a four cylinder engine having a bore and stroke of 3.875 x 5.06 inches and a displacement of 239 cubic inches. Models 784 and Hydro 84 diesel tractors are equipped with a four cylinder engine having a bore and stroke of 3.937 x 5.06 inches and a displacement of 246 cubic inches. Model 884 diesel tractors are equipped with a four cylinder engine having a bore and stroke of 3.937 x 5.50 inches and a displacement of 268 cubic inches.

R&R ENGINE ASSEMBLY

All Models

25. To remove the engine assembly, first remove hood and rear side panels. Drain cooling system and disconnect battery ground cable. Disconnect wires from alternator, from starter and from headlights and ether injector. Disconnect steering lines and oil cooler lines and plug openings to prevent dirt from entering system. Disconnect air cleaner scoop and radiator hoses. Support tractor under clutch or hydrostatic drive housing, attach hoist to front support, then unbolt and remove front support, radiator, axle and wheels as an assembly. Shut off fuel and disconnect the inlet line at filter base and the fuel return line at the tee connector. Disconnect the fuel shut-off cable from injection pump. Disconnect air cleaner restriction switch, temperature and oil pressure wires and remove breather tube assembly from right side of engine. Disconnect throttle rod at right rear of engine and disconnect the tachometer drive cable. Attach a hoist to engine, then unbolt and remove engine assembly.

Reinstall engine by reversing the removal procedure. Use aligning dowels so engine will be guided straight together. On standard (gear drive) transmission equipped models, unbolt and remove clutch assembly from flywheel. Place pressure plate assembly and clutch disc on shafts in clutch housing. Clutch can be bolted to flywheel after engine is installed by working through the opening at bottom of clutch housing. If flywheel and clutch plate balancing marks are indicated (dab of white paint), they must be aligned.

CYLINDER HEAD

All Models

26. **REMOVE AND REINSTALL.** Drain coolant, remove hood and disconnect battery ground cable. Unbolt and remove air cleaner, then disconnect upper radiator hose and by-pass hose. Disconnect injector lines from fuel injectors and injection pump. Cap or plug all fuel connections immediately after they are disconnected to prevent entrance of dirt or other foreign material. Unbolt and remove exhaust manifold and water collecting tube from right side and inlet manifold from left side of cylinder head. Remove rocker arm cover, rocker arms and shaft assembly and push rods. Remove cylinder head cap screws and lift off cylinder head.

CAUTION: The injector nozzle assemblies protrude slightly through the combustion side of cylinder head. Be extremely careful, when removing or reinstalling cylinder head with injectors installed, not to damage injector ends. DO NOT place cylinder head on bench with combustion side down.

When reinstalling cylinder head, use new head gasket and make certain gasket sealing surfaces are clean. Use guide studs when installing the head.

Tighten cylinder head retaining cap screws in three steps using the sequence shown in Fig. 35. Tighten the cap screws to a torque of 30 ft.-lbs. in first step, 60 ft.-lbs. in second step and 90 ft.-lbs. in

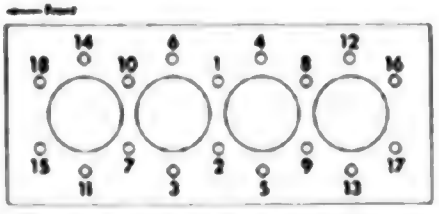


Fig. 35 – Tighten cylinder head cap screws on all models in the sequence shown.

third step. Adjust valve tappet gap to 0.012 inch for both intake and exhaust as outlined in paragraph 28.

NOZZLE SLEEVES

All Models

27. The cylinder head is fitted with brass injector nozzle sleeves which pass through the coolant passages. The nozzle sleeves are available as service items.

To renew the nozzle sleeves, remove cylinder head as outlined in paragraph 26, then remove injectors. Use special bolt (IH tool No. FES 112-4) and turn it into sleeve. Attach a slide hammer puller and remove nozzle sleeve. See Fig. 36. Use caution during this operation not to damage the sealing areas in the cylinder head.

NOTE: Under no circumstances should screwdrivers, chisels or other such tools be used in an attempt to remove injector nozzle sleeves.

When installing nozzle sleeves, be sure the sealing areas are completely clean and free of scratches. Apply a light coat of "Grade B Loctite" on sealing surfaces of nozzle sleeves, then using installing tool (IH tool No. FES 112-3) as shown in Fig. 37, drive nozzle sleeves into their bores until they bottom as shown in Fig. 38.

NOTE: Injector nozzle sleeves have a slight interference fit in their bores. When installing sleeves, make certain sleeve is driven straight with its bore.

VALVES AND SEATS

All Models

28. Inlet and exhaust valves are not interchangeable. The inlet valves seat directly in the cylinder head and the exhaust valves seat on renewable seat inserts. Inserts are available in oversizes of 0.004 and 0.016 inch.

Valve face and seat angle for both the inlet and exhaust valves is 45 degrees. Valve stem seals are used on all valves.

When removing valve seat inserts, use the proper seat puller or use a pre-cup puller and expanding screw. DO NOT attempt to drive a chisel or similar tool under insert or the counterbore will be damaged. Chill new inserts with dry ice or liquid Freon prior to installing. When new insert is properly bottomed, it should be 0.008-0.030 inch below edge of counterbore. After installation, peen the cylinder head material around the complete outer circumference of the valve seat insert.

Check the valves and seats against the following specifications:

Inlet

Face and seat angle	45°
Stem diameter	0.3919-0.3923 in.
Stem to guide diametral clearance	0.0014-0.0026 in.
Seat width	0.076-0.080 in.
Valve run-out (max.)	0.001 in.
Valve tappet gap (warm)	0.012 in.
Valve recession from face of cylinder head:	
Normal	0.039-0.055 in.
Maximum	0.120 in.

Exhaust

Face and seat angle	45°
Stem diameter	0.3911-0.3915 in.
Stem to guide diametral clearance	0.0022-0.0034 in.
Seat width	0.081-0.089 in.
Valve run-out (max.)	0.001 in.
Valve tappet gap (warm)	0.012 in.
Valve recession from face of cylinder head:	
Normal	0.047-0.063 in.
Maximum	0.120 in.

To adjust valve tappet gap, crank engine to position number one piston at TDC of compression stroke. Adjust the four valves indicated on the chart shown in Fig. 39. Then, turn engine crankshaft one complete revolution to position number four piston at TDC of compression stroke and adjust the remaining four valves indicated on chart.

VALVE GUIDES AND SPRINGS

All Models

29. The inlet and exhaust valve guides are interchangeable. Inlet and exhaust

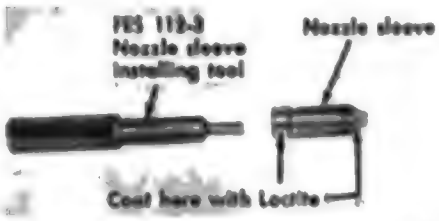


Fig. 37 – Injector nozzle sleeve installing tool. Apply "Grade B Loctite" to sealing surface of nozzle sleeve.

Fig. 36 – Use IH Tool No. FES 112-4 and slide hammer to remove injector nozzle sleeve.

Fig. 38 – Drive nozzle sleeves into cylinder head until they bottom.

With	Adjust Valves (Engine Warm)							
No. 1 Piston at T.D.C. (Compression)	1	2		4	5			
No. 4 Piston at T.D.C. (Compression)			3			6	7	8

Fig. 39 – Chart shows valve tappet adjusting procedure used on D239, D246 and D268 diesel engines.

Numbering sequence of valves which correspond to chart

guides should be pressed into cylinder head until top of guides are 1.154-1.169 inches above spring recess in the head. Guides must be reamed to size after installation. Inside diameter of guides should be 0.3937-0.3945 inch and valve stem to guide diametral clearance should be 0.0014-0.0026 inch for inlet valves and 0.0022-0.0034 inch for exhaust valves.

Inlet and exhaust valve springs are also interchangeable. Springs should have a free length of 2.173-2.181 inches and should test 145-160 pounds when compressed to a length of 1.346 inches. Renew any spring which is rusted, discolored or does not meet the pressure test specifications.

VALVE TAPPETS (Cam Followers)

All Models

30. The 0.7862-0.7868 inch diameter mushroom type tappets operate directly in the unbushed crankcase bores. Clearance of tappets in the bores should be 0.0004-0.0023 inch. Tappets can be removed after first removing the camshaft as outlined in paragraph 38. Oversize tappets are not available.

VALVE LEVERS (Rocker Arms)

All Models

31. Removal of the rocker arms and shaft assembly is conventional. To remove the rocker arms from the shaft, remove bracket clamp bolts and slide all parts from shaft. Outside diameter of rocker shaft is 0.8491-0.8501 inch. The renewable bushing in rocker arms should have an operating clearance of 0.0009-0.0025 inch on the rocker shaft with a maximum allowable clearance of 0.006 inch. Rocker arm adjusting screws are self-locking. If they turn with less than 12 ft.-lbs. torque, renew adjusting screw and/or rocker arm.

Reassemble rocker arms on rocker shaft, keeping the following points in mind. Thrust washers are used between each spring and rocker arms, and spacer rings are used between rocker arms and brackets except between rear rocker arm and rear bracket. To insure the lubrication holes in rocker shaft are in correct position, align punch mark on front end of rocker shaft with slot in front mounting bracket as shown in Fig. 40. End of shaft must also be flush with bracket. The rocker shaft clamp bolts on brackets should be tightened to a torque of 8 ft.-lbs. Tighten the hold down nuts on bracket studs to a torque of 47 ft.-lbs.

VALVE TIMING

All Models

32. To check valve timing, remove rocker arm cover and crank engine to position number one piston at TDC of compression stroke. Adjust number one intake valve tappet gap to 0.014 inch. Place a 0.004 inch feeler gage between valve lever and valve stem of number one intake. Slowly rotate crankshaft in normal direction of rotation until valve lever becomes tight on feeler gage. At this point, number one intake valve will start to open and timing pointer should be within the range of 23 to 29 degrees before top dead center.

NOTE: One tooth out of time equals approximately 11 degrees.

Readjust number one intake valve tappet gap as outlined in paragraph 28.

TIMING GEAR COVER

All Models

33. To remove the timing gear cover, first remove hood, drain cooling system and disconnect battery ground cable. Disconnect wires to headlights and alternator, then unbolt and remove alternator. Identify and disconnect steering lines and oil cooler lines and plug openings to prevent entrance of dirt into the system. Disconnect air cleaner scoop and radiator hoses. Support tractor under clutch or hydrostatic drive housing, attach hoist to front support, then unbolt and remove front support, radiator, axle and wheels as an assembly. Unbolt and remove fan, fan pulley, belt, cross-over fuel line and water pump. Then, unbolt and remove oil pan. Disconnect tachometer drive cable and remove tachometer drive. Do not lose the small driving tang when removing tachometer drive. On Models 684, 784 and Hydro 84, remove the three cap screws and flat washer, tap crankshaft pulley with a plastic hammer to loosen clamping ring, then slide clamping ring and crankshaft pulley from end of crankshaft. On Model 884, remove the three cap screws and flat washer, tap crankshaft pulley with a plastic hammer to loosen the pressure rings and spring tightener elements, then remove crankshaft pulley assembly. On all models, unbolt timing gear cover, then pull cover forward off the dowels and remove from engine.

Reassemble by reversing the disassembly procedure. When installing the crankshaft pulley, slide pulley on crankshaft and align with timing pin. On Models 684, 784 and Hydro 84, install clamping ring, flat washer and three cap screws. On Model 884, install first spring element, first pressure ring, second spring element, second pressure ring, flat washer and three cap screws. Then, on all models, tighten cap screws evenly in three steps to a torque of 22 ft.-lbs., 44 ft.-lbs. and finally to 57 ft.-lbs.

TIMING GEARS

All Models

34. **CRANKSHAFT GEAR.** Crankshaft gear is a shrink fit on crankshaft. To renew the gear, it is recommended that the crankshaft be removed from the engine. Then, using a chisel and hammer, split the gear at its timing slot.

The roll pin for indexing crankshaft gear on crankshaft must protrude approximately 5/64-inch. Heat new gear to 400°F. and install it against bearing journal. Make certain all timing marks are aligned as shown in Fig. 41.

35. **CAMSHAFT GEAR.** Camshaft gear is a shrink fit on the camshaft. To renew the gear, remove camshaft as outlined in paragraph 38. Gear can now be pressed off in conventional manner, using care not to damage the tachometer drive slot in end of camshaft.

When reassembling, install thrust plate and Woodruff key. Heat gear to 400°F. and install it on camshaft.

NOTE: When sliding gear on camshaft, set thrust plate clearance at 0.004-0.018 inch.

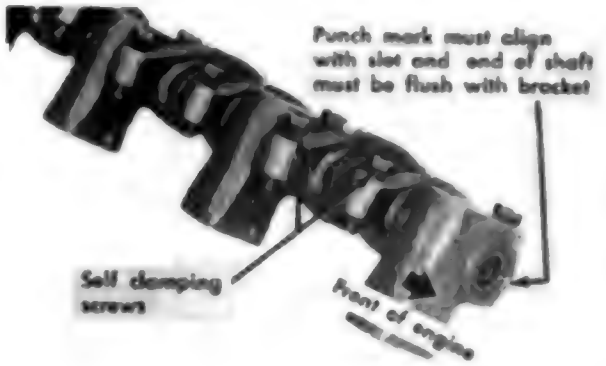


Fig. 40 – Align punch mark on front end of rocker shaft with slot in front mounting bracket. End of shaft must be flush with bracket.

Install camshaft assembly and make certain all timing marks are aligned as shown in Fig. 41.

36. **IDLER GEAR.** To remove idler gear, first remove timing gear cover as outlined in paragraph 33. Idler gear shaft is attached to front of engine by a special (left hand thread) cap screw.

Idler gear is equipped with two renewable needle bearings. A spacer is used between the bearings.

When installing idler gear, coat threads of special cap screw with "Loctite" and tighten cap screw to a torque of 67 ft.-lbs. End clearance of gear on shaft should be 0.008-0.013 inch. Align timing marks, on all timing gears as shown in Fig. 41.

Timing gear backlash should be as follows:

Idler to crankshaft gear:
New gears.....0.007-0.015 in.
Used gears (max.).....0.027 in.
Idler to camshaft gear:
New gears.....0.0035-0.0106 in.
Used gears (max.).....0.0226 in.
Idler to injection pump drive gear:
New gears.....0.0021-0.012 in.
Used gears (max.).....0.024 in.

37. **INJECTION PUMP DRIVE GEAR.** To remove the drive gear, first remove timing gear cover as outlined in paragraph 33. Remove drive shaft nut and washer and the three hub cap screws. Attach puller (IH tool No. FES 111-2) or equivalent to threaded holes in gear and pull gear and hub from shaft.

When reassembling, make certain all timing marks are aligned as shown in Fig. 41. The pump drive gear is used on several different engines and is equipped with six timing marks. On D239, D246 and D268 engines, use the timing dot next to number 4 on the drive gear. Refer to paragraph 56 and retime injection pump. Tighten drive shaft nut to a torque of 48 ft.-lbs. and the three hub cap screws to a torque of 20 ft.-lbs.

CAMSHAFT AND BEARINGS

All Models

38. **CAMSHAFT.** To remove the camshaft, first remove timing gear cover as outlined in paragraph 33. Then, remove rocker arm assembly and push rods. Remove engine side cover and secure cam followers (tappets) in raised position with clothes pins or rubber bands. Working through openings in camshaft gear, remove camshaft thrust plate retaining cap screws. Carefully withdraw camshaft assembly.

Recommended camshaft end play is 0.004-0.018 inch. Camshaft bearing journal diameter should be 2.2823-2.2835 inches.

Reinstall camshaft by reversing the removal procedure. Make certain timing marks are aligned as shown in Fig. 41.

39. **CAMSHAFT BEARINGS.** To remove the camshaft bearings, first remove the engine as outlined in paragraph 25 and camshaft as in paragraph 38. Unbolt and remove clutch (gear drive) or drive plate (hydrostatic drive), flywheel and engine rear end plate. Remove expansion plug from behind camshaft rear bearing and remove the bearings.

NOTE: Camshaft bushings are furnished semifinished for service and must be align reamed after installation to an inside diameter of 2.2844-2.2856 inches.

Install new bearings so that oil holes in bearings are in register with oil holes in crankcase. Normal operating clearance of camshaft journals in bearings is 0.0009-0.0033 inch. Maximum allowable clearance is 0.0045 inch.

When installing expansion plug at rear camshaft bearing, apply a light coat of sealing compound to edge of plug and bore.

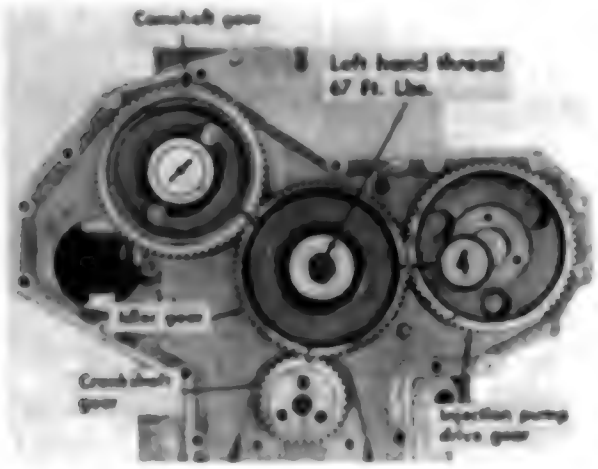


Fig. 41—Gear train and timing marks. Use timing dot next to number 4 on injection pump drive gear on D239, D246 and D268 engines.

ROD AND PISTON UNITS

All Models

40. Connecting rod and piston assemblies can be removed from above after removing the cylinder head as outlined in paragraph 26 and the oil pan and engine balancer.

Cylinder numbers are stamped on the connecting rod and cap. Stamp any new or unmarked rod and cap assemblies with correct cylinder numbers. Numbers on rod and cap should be in register and face toward camshaft side of engine. The arrow stamped on the top of pistons should point toward front of engine.

Tighten the connecting rod nuts to a torque of 61 ft.-lbs.

PISTONS, SLEEVES AND RINGS

All Models

41. Pistons are available as individual service parts, but when being reused should be treated as matched units with the wet type sleeves. New pistons have a diametral clearance in new sleeves of 0.0039-0.0047 inch when measured between piston skirt and sleeve at 90 degrees to piston pin.

The wet type cylinder sleeves should be renewed when out-of-round or taper exceeds 0.0063 inch. Inside diameter of new sleeves is 3.875-3.8754 inches on D239 engine and 3.937-3.9375 inches on D246 or D268 engines. Cylinder sleeves can usually be removed by bumping them from the bottom with a block of wood.

Sleeves are plateau honed and should never be deglazed by honing on re-ring jobs. Remove oil and varnish glaze with a 50/50 mixture of hot water and liquid detergent.

Before installing new sleeves, thoroughly clean counterbore at top and seal ring groove at bottom. All sleeves should enter crankcase bores full depth and should be free to rotate by hand when tried in bores without seal rings. After making a trial installation without seal rings, remove sleeves and install new seal rings dry into grooves in crankcase. Coat lower end of sleeve with a light film of motor oil and install sleeve.

NOTE: On early production engines, the cut-outs in bottom of sleeve are for connecting rod clearance and must be installed toward each side of engine. Chisel marks are provided on top edge of cylinder sleeve to aid in correct installation. Align chisel marks from front to rear of engine. Late production sleeves are shorter and have no cut-outs.

If seal ring is in place and not pinched,

very little hand pressure is required to press the sleeve completely in place. Sleeve flange should extend 0.003-0.005 inch above top surface of cylinder block. If sleeve stand-out is excessive, check for foreign material under the sleeve flange. The cylinder head gasket forms the upper cylinder sleeve seal and excessive sleeve stand-out will result in coolant leakage.

Pistons are fitted with two compression rings and one oil control ring. The top compression ring is a chrome face full keystone ring and is installed either side up.

The second compression ring is a taper face ring and is installed with largest outside diameter toward bottom of piston. Upper side of ring is marked TOP.

The oil control ring can be installed either side up, but make certain the coil spring expander is completely in its groove.

Additional piston ring information is as follows:

Ring End Gap:
- Compression rings . . . . 0.014-0.025 in.
- Oil control ring . . . . . 0.010-0.019 in.

Ring Side Clearance:
- Top compression, (ring drop) . . . . . 0.002-0.015 in.
- Second compression . 0.0030-0.0042 in.
- Oil control . . . . . 0.0014-0.0024 in.

Since it is not possible to check the side clearance of the full keystone top compression ring with a feeler gage, check fit of ring as follows: Place new ring in its groove in piston and push ring into groove as far as possible. Measure the distance ring is below ring land. This distance should be 0.002-0.015 inch. Refer to Fig. 42 for view showing ring fit being checked using IH tools FES 68-3 and dial indicator FES 67.

PISTON PINS

All Models

42. The full floating type piston pins are retained in the piston bosses by snap rings. Specifications are as follows:

Piston pin diameter . . . 1.4172-1.4173 in.
Piston pin diametral clearance
- in piston . . . 0.0000-0.0001 in. (tight)
- Maximum . . . . . 0.0002 in. (loose)

Piston pin diametral clearance
- in bushing . . . . . 0.0005-0.0011 in.
- Maximum . . . . . 0.002 in.

CONNECTING RODS AND BEARINGS

All Models

43. Connecting rod bearings are of the slip-in, precision type, renewable from below after removing oil pan, engine balancer and connecting rod caps.

When installing new bearing inserts, make certain that projections on same engage slots in connecting rod and cap. Also, make certain that cylinder identifying numbers on rod and cap are in register and face toward camshaft side of engine. Numbers on rod and cap should be stamped on same side as the flat boss on small end of rod.

Connecting rod bearings are available in standard size as well as undersizes of 0.010, 0.020 and 0.030 inch.

Check crankshaft crankpins and connecting rod bearings against the values which follow:

Crankpin diameter . . . 2.5185-2.5193 in.
Max. allowable out-of-round . . 0.0012 in.
Diametral clearance . . 0.0023-0.0048 in.
Rod side clearance . . . . . 0.006-0.010 in.
Rod bolt torque . . . . . 61 ft.-lbs.

CRANKSHAFT AND MAIN BEARINGS

All Models

44. The crankshaft is supported in five main bearings. Main bearings are of the non-adjustable, slip-in, precision type, renewable from below after splitting tractor between engine and clutch or hydrostatic drive housing to remove flywheel for access to the two cap screws securing the seal bar below rear main cap and then removing the oil pan, engine balancer, seal bar and main bearing caps. Crankshaft end play is controlled by the flanged rear main bearing inserts. Removal of the crankshaft requires R&R of engine. Check crankshaft and main bearings against the values which follow:

Crankpin diameter . . . 2.5185-2.5193 in.

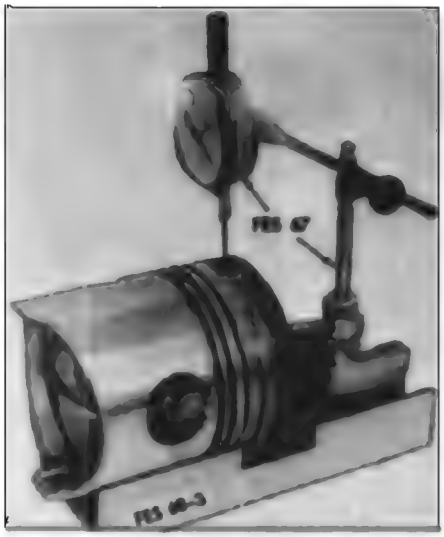


Fig. 42 — View showing full keystone ring fit being checked. Ring drop should be 0.002-0.015 inch. Refer to text.

Main journal diameter . . . . . 3.1484-3.1492 in.
Max. allowable out-of-round . . 0.002 in.
Crankshaft end play . . . 0.006-0.009 in.
Main bearing diametral clearance . . . . . 0.0028-0.0055 in.
Main bearing bolt torque, ft.-lbs.:
- Necked down bolts,
  - Marked 10.9K 80*
  - Marked 12.9K 100*
- Pitch diameter bolts,
  - Marked 10.9K 105*
  - Marked 12.9K 141*

*With lubricated threads.

Necked down bolts have a shank diameter of 0.410 inch. Pitch diameter bolts have a shank diameter of 0.500 inch. Tighten main bearing bolts in three steps; first to 30 ft.-lbs., second to 60 ft.-lbs. and third to the final torque listed.

Main bearings are available in standard size and undersizes of 0.010, 0.020 and 0.030 inch.

CRANKSHAFT SEALS

All Models

45. **FRONT.** To renew the crankshaft front oil seal, first remove hood, drain cooling system and disconnect radiator hoses. Disconnect air cleaner scoop and wires to headlights. Identify and disconnect steering lines and oil cooler lines and plug openings to prevent dirt from entering system. Support tractor under clutch or hydrostatic drive housing and attach hoist to front support. Then, unbolt and remove front support, radiator, axle and wheels as an assembly. Remove belt from crankshaft pulley.

On Models 684, 784 and Hydro 84, remove the three cap screws and flat washer, tap crankshaft pulley with a plastic hammer to loosen clamping ring, then slide clamping ring and crankshaft pulley from end of crankshaft. On Model 884, remove the three cap screws and flat washer, tap crankshaft pulley with a plastic hammer to loosen the pressure rings and spring tightener elements, then remove crankshaft pulley assembly. Then, on all models, remove the oil seal wear ring from crankshaft, then remove and renew oil seal in conventional manner. Renew "O" ring on crankshaft. Inspect wear ring and timing pin for wear or other damage and renew as necessary. Use a non-hardening sealer on timing pin. When installing wear ring, timing pin must engage slot in crankshaft gear. Slide pulley onto crankshaft, aligning slot in pulley with timing pin in wear ring. On Models 684, 784 and Hydro 84, install clamping ring, flat washer and three cap screws. On Model 884, install first spring element, first pressure ring, sec-

ond spring element, second pressure ring, flat washer and three cap screws. Then, on all models, tighten the cap screws evenly in three steps to a torque of 22 ft.-lbs., 44 ft.-lbs. and finally to 57 ft.-lbs.

46. **REAR.** To renew crankshaft rear oil seal, the engine must be detached from clutch or hydrostatic drive housing as follows: Disconnect battery cables and remove hood and rear side panels. Disconnect the tachometer cable and electrical wiring from engine and lay the cable and wiring harness rearward. Shut off fuel and disconnect fuel lines. Disconnect fuel shut-off cable at injection pump and throttle rod at right rear of engine. Unbolt and remove starter and crankcase breather. Identify and disconnect steering lines and oil cooler lines and plug openings to prevent dirt from entering system. Attach a hoist or split stand to engine and support clutch or hydrostatic drive housing with a rolling floor jack. Unbolt engine from center section and roll rear section of tractor from engine. Unbolt and remove clutch (gear drive) or drive plate (hydrostatic drive) and the flywheel.

Unbolt and remove seal retainer and seal assembly. Check the position that old seal is installed in retainer. New seal can be installed in any of three locations. 1/16-inch above flush with retainer (new engine original position), flush with retainer or 1/16-inch below flush with retainer. Location of seal in retainer will depend on condition of the sealing surface on crankshaft. Use new gasket and install seal retainer with new seal. Tighten retainer bolts to a torque of 14 ft.-lbs. Install flywheel and tighten bolts to a torque of 110 ft.-lbs.

On Model Hydro 84, bolt hydrostatic drive plate to flywheel, apply a light coat of "Molycote" or equivalent to hydrostatic drive input shaft splines, then roll tractor together.

On Models 684, 784 and 884, place clutch pressure plate and clutch disc on shafts in clutch housing. Roll tractor together. Clutch can be bolted to flywheel after tractor is reparied by working through opening at bottom of clutch housing. If flywheel and clutch plate balancing marks are indicated (dab of white paint), they must be aligned.

FLYWHEEL

All Models

47. To remove the flywheel, refer to the procedure outlined in paragraph 46.

To install a new flywheel ring gear, heat same to approximately 500 degrees F.

Tighten flywheel retaining cap screws to a torque of 110 ft.-lbs.

ENGINE BALANCER

All Models

48. D239, D246 and D268 engines are equipped with an engine balancer which is mounted on underside of engine crankcase. Balancers are driven by a renewable gear (2 - Fig. 43) which is a shrink fit on crankshaft. The balancer consists of two unbalanced gear weights which rotate in opposite directions at twice crankshaft speed. They produce forces which tend to counteract the vibration which is inherent in four cylinder engines having a single plane crankshaft (1 and 4 throws displaced 180 degrees from throws 2 and 3). It is extremely important that balancer weights are correctly timed to each other and that complete unit is timed to crankshaft.

49 **R&R AND OVERHAUL.** To remove the engine balancer, drain oil and remove oil pan as in paragraph 52. Unbolt and remove oil suction tube assembly and "O" ring. Remove the two remaining cap screws and remove balancer from crankcase.

To disassemble the balancer unit, drive roll pins (8 - Fig. 43) out of housing and into weight shafts (5). Press or bump shafts out roll pin side of housing (7) and lift out weight gear assemblies (3 and 4). Drive roll pins (8) out of shafts.

Clean and inspect all parts for excessive wear or other damage. Refer to specifications which follow to determine parts renewal and operating clearances.

Backlash, crankshaft gear to weight gear	0.010-0.016 in.
Backlash between weight gears	0.007-0.009 in.
Weight gear bushing I.D.	0.9082-0.9094 in.
Shaft bearing surface diameter	0.9051-0.9055 in.
Weight gear operating clearance on shaft	0.0027-0.0043 in.
Weight gear end clearance in housing	0.008-0.016 in.

NOTE: Weight gear bushings are not catalogued separately; if bushings show excessive wear, renew weight gear assemblies.

When reassembling, make certain that oil passages in housing and shafts are clean. Lubricate shafts and weight gear bushings and place drive weight gear (4) in housing. Install weight shaft from roll pin side of housing through the weight gear. Align roll pin hole in shaft with roll

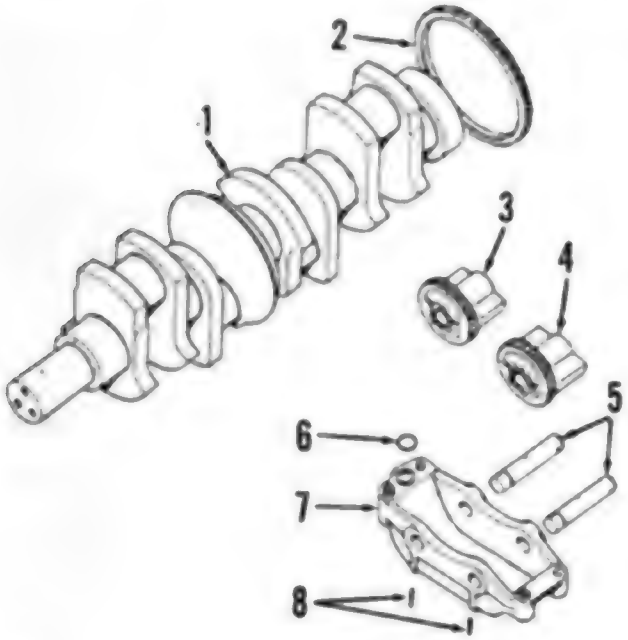


Fig. 43 - Exploded view of engine balancer used on all models. Balancer drive gear (2) is a shrink fit on crankshaft.

1. Crankshaft
2. Balancer drive gear
3. Driven weight assy.
4. Drive weight assy.
5. Weight shafts
6. "O" ring
7. Housing
8. Double roll pins

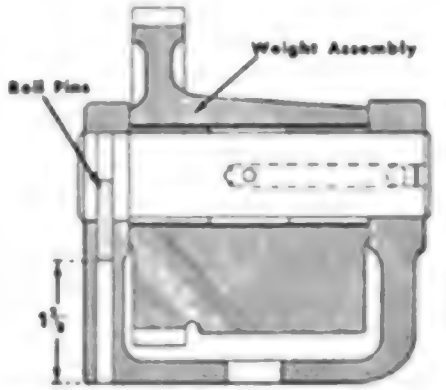


Fig. 44 - Sectional view of balancer weight gear, housing and shaft showing correct installation of roll pins. Roll pins must be shorter than shaft diameter.

pin hole in housing and tap shaft into position. Install roll pins as shown in Fig. 44.

NOTE: Roll pins must be shorter than shaft diameter.

Install roll pins to a depth of 1⅝ inches in roll pin bosses. Place idler weight in housing and with both weights down, mesh teeth so that timing marks are aligned. Install second shaft and secure with double roll pin. Using a dial indicator, check backlash between weight gears. Backlash should be 0.007-0.009 inch. If backlash is excessive, renew weight gear assemblies.

To install the balancer assembly, first rotate crankshaft to position No. 2 piston at TDC of compression stroke. Place new "O" ring (6 – Fig. 43) in recess on balancer. Then, with weights toward bottom of balancer housing and weight gear timing marks aligned, install balancer so that timing mark on drive weight is aligned with timing mark on balancer drive gear (2). Using a new "O" ring, install oil suction tube assembly. Using a dial indicator, check backlash between balancer drive weight gear (4) and balancer drive gear (2). Backlash should be 0.010-0.016 inch.

NOTE: When backlash between weight gears (3 and 4) is correct (0.007-0.009 inch) and backlash between balancer drive gear (2) and drive weight gear exceeds 0.016 inch, balancer drive gear (2) is excessively worn and should be renewed. Refer to paragraph 50.

Install oil pan with new pan gasket and fill crankcase to proper level with new oil.

50. **RENEW BALANCER DRIVE GEAR.** To renew balancer drive gear (2 – Fig. 43), first remove crankshaft from engine. Remove worn or damaged drive gear by using a chisel and hammer and splitting the gear. Remove any burrs which might be present on gear mounting surface of crankshaft. Heat new gear to 360-390 degrees F., align the single mark (below tooth space of the drive gear) with the notch on the crankshaft flange and slide drive gear on crankshaft. The two marked teeth on drive gear should be toward flywheel end of crankshaft.

OIL PUMP AND RELIEF VALVE

All Models

51. The internally mounted gear type oil pump is driven from the crankshaft gear and is accessible for removal after removing the engine oil pan.

The pump is mounted to the front main bearing cap. Remove the cap and pump assembly. Leave bearing cap on pump (Fig. 45) when repairing oil pump. The cap can be clamped in a vise to support the pump. If removal of cap is necessary, take off the bearing adjusting nut and tab lockwasher. Remove the idler gear to obtain access to the mounting bolts.

Removing the relief valve is obvious after an examination of unit and reference to Fig. 45. Specifications for relief valve are as follows:

Valve diameter	0.825-0.827 in.
Valve clearance in bore	0.003-0.007 in.
Valve spring (used):	
Free length	2.520 in.
Test length	1.858 in.
Test load	18-20 lbs.
Valve spring (new):	
Free length	2.85 in.
Test length	1.86 in.
Test load	33 lbs.

To disassemble the pump, remove the snap ring from rear end of pump and the cover nuts. The cover and body have dowel pins and will have to be tapped lightly with a plastic hammer to separate. Remove the body gears and Woodruff key from the drive gear shaft.

Inspect all parts for scoring, excessive wear or other damage. Check pump against the following specifications:

Drive shaft end play (cover installed)	0.000-0.002 in.
Drive shaft running clearance (in bushings)	0.001-0.0032 in.
Radial clearance (gears to body)	0.007-0.012 in.
Idler gear running clearance (on shaft)	0.001-0.0032 in.
Idler gear end clearance	0.002-0.0038 in.
Oil pressure at rated rpm	40-60 psi

When reassembling, the pump front cover if removed, must be bolted to main bearing cap before the idler gear is installed. Refer to Fig. 46, install idler gear and adjust bearings to an end play of 0.000-0.002 inch. Install pump and main bearing cap on crankshaft and torque the bolts to values outlined in paragraph 44.

Install oil pan with new gasket and fill crankcase to proper level with new oil.

OIL PAN

All Models

52. To remove the oil pan, place a jack under center section of tractor. Remove the lower six bolts and loosen the upper two bolts in the front bolster to engine. Remove the pan bolts; there are three pan bolts partly hidden between the pan and center section housing. Oil pan can now be removed.

Install oil pan with new gasket and tighten pan bolts to a torque of 24 ft.-lbs. Fill crankcase to proper level with new oil.

OIL COOLER

Model 884

53. An engine oil cooler is located on the right side of engine on Model 884 tractors and is attached to the oil filter base. See Fig. 47. The oil cooler relief valve (6 through 9) is located in the oil filter base (13). Inspect oil cooler relief valve (9) for freeness in its bore.

Normal cleaning of the oil cooler (1) consists of blowing out water tubes with

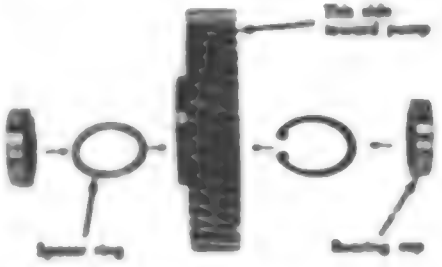


Fig. 46 – View showing assembly procedure for oil pump idler gear bearing cups.

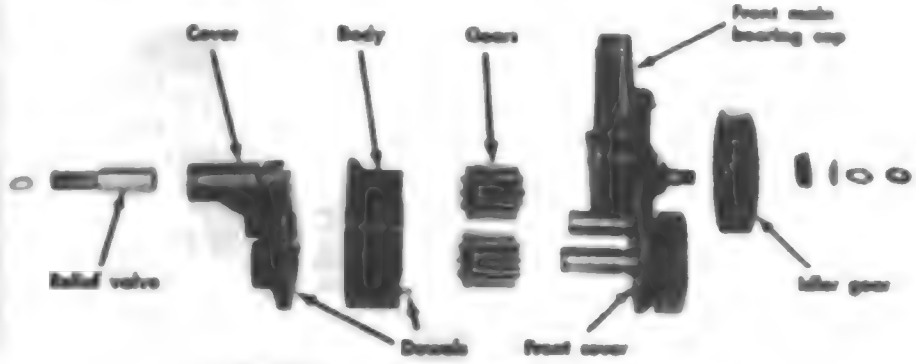


Fig. 45 – Exploded view of oil pump used on all models.

compressed air and flushing oil passages with a suitable cleaning solvent. Renew "O" rings (2) and gasket (4) when reassembling.

DIESEL FUEL SYSTEM

The diesel fuel system on D239, D248 and D268 engines are direct injection type equipped with a Robert Bosch injection pump.

When servicing any unit of the diesel fuel system, the maintenance of absolute cleanliness is of utmost importance. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

Probably the most important precaution that service personnel can impart to owners of diesel powered tractors, is to urge them to use an approved fuel that is absolutely clean and free from foreign material. Extra precaution should be taken to make certain that no water enters the fuel storage tanks.

FILTERS AND BLEEDING

All Models

54. All models except Model 884, are equipped with two diesel fuel filters located on right side of engine. The two filters are located on left side of engine on Model 884. To renew filter elements, shut off fuel at tank and open vent screw (13–Fig. 48) and drain valves (12). Allow fuel to drain from filters, unscrew acorn nuts (1) at top of filter head, remove retaining bolts (10) and sediment bowls (8), then discard filter elements (6 and 14).

Install new filter elements, using new "O" rings (4, 5 and 7). Clean and install sediment bowls and secure with retaining bolts and acorn nuts, using new sealing washers (2, 9 and 11). Tighten acorn nut to a torque of 6 ft.-lbs. maximum. Close vent screw and drain valves.

Bleed air from fuel system as follows: Open fuel shut-off valve at tank and open vent screw (13) above final filter on filter head. Allow fuel to run until a solid stream with no air bubbles appears, then close vent screw.

NOTE: The life of filter elements depends on the amount of contamination they must remove from the fuel. If engine misfires or loss of power is evident, change the elements. In any event, filter elements must be changed after each 800 hours of operation.

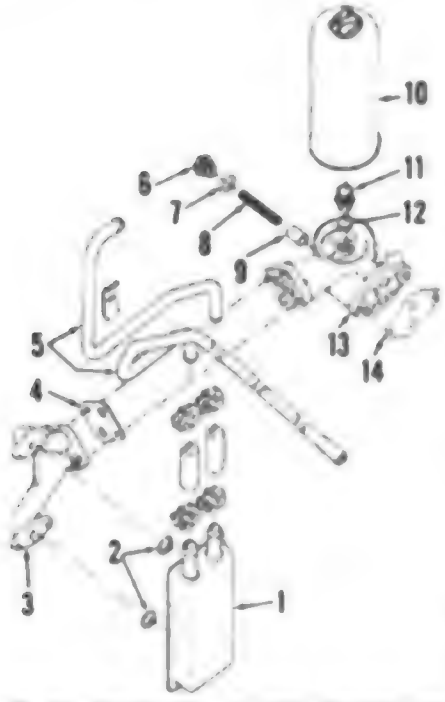


Fig. 47 – Exploded view of engine oil cooler and oil filter assembly used on Model 884. Oil cooler relief valve (6 through 9) is located in filter base (13).

1. Oil cooler
2. "O" rings
3. Manifold
4. Gasket
5. Water pipe
6. Plug
7. Gasket
8. Spacer
9. Relief valve
10. Filter element
11. Connector
12. Seal ring
13. Filter base
14. Gasket

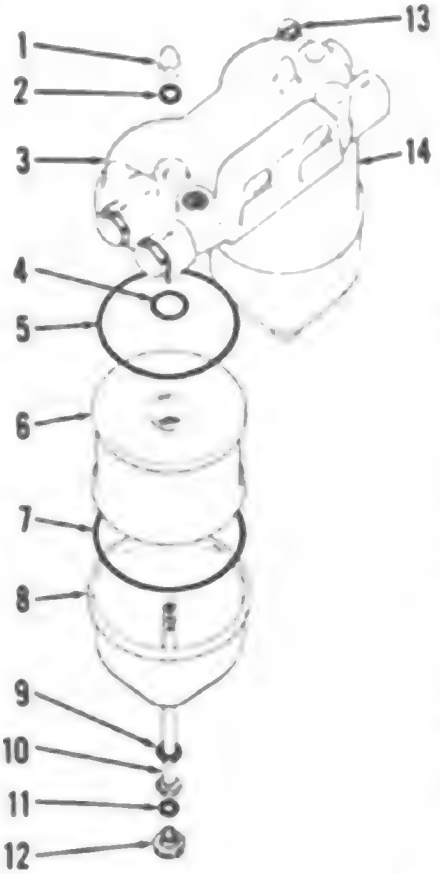


Fig. 48 – Partially exploded view of dual fuel filters used on all models.

1. Acorn nut
2. Sealing washer
3. Filter head
4. "O" ring
5. "O" ring
6. Primary filter element
7. "O" ring
8. Sediment bowl
9. Sealing washer
10. Retaining bolt
11. Sealing washer
12. Drain valve
13. Vent screw
14. Final filter element

INJECTION PUMP

All models use a Robert Bosch Model CR diesel pump which is a distributor type and is completely sealed.

Because of the special equipment needed, and skill required of servicing personnel, service of injection pumps is generally beyond the scope of that which should be attempted in the average shop. Therefore, this section will include only timing of pump to engine, removal and installation and the linkage adjustments which control the engine speeds.

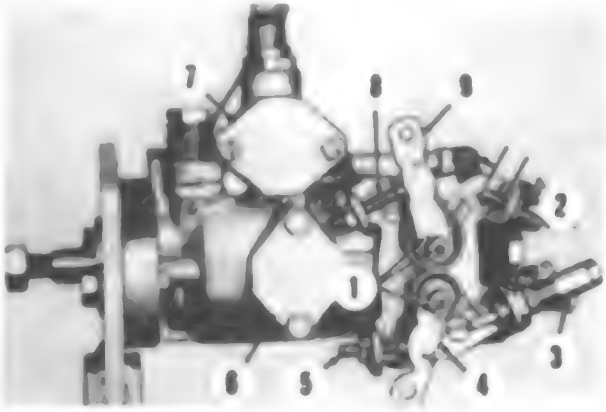
If additional service is required, the pump should be turned over to an International Harvester facility which is equipped for diesel service, or to some other authorized diesel service station. Inexperienced personnel should NEVER attempt to service diesel injection pumps.

All Models

55. REMOVE AND REINSTALL. To remove the injection pump, first thoroughly clean the pump, lines and side of engine. Shut off fuel and remove timing hole cover (6–Fig. 49). Turn

Fig. 49 – Model CR Robert Bosch injection pump mounted in holding fixture (JH tool FES 111-1). Advance spring cap is on other side of pump directly opposite from plate (7).

1. Lower and shaft alignment marks
2. High idle speed stop screw
3. Engine fuel and shut-off plunger
4. Pump cooling cover
5. Maximum fuel shut screw
6. Timing cover
7. Advance piston plate
8. Low idle speed stop screw
9. Speed control lever



crankshaft in normal direction of rotation until the timing line on face cam is aligned with the timing pointer in pump.

NOTE: The face cam has two timing lines. Near one of the lines, a letter "L" is etched on the face cam. DO NOT use this line as it is used only to time left hand rotation pumps.

When the correct timing line is in register with the timing pointer in pump, the timing pointer on timing gear cover should be aligned with the 16 degree BTDC mark on crankshaft pulley. Disconnect throttle control rod and shut-off cable from pump. Disconnect fuel inlet and return lines from pump, then remove high pressure injection lines. Immediately cap or plug all openings. Unbolt and remove rectangular cover from front of timing gear cover. Remove nut and washer from pump drive shaft, then remove three cap screws securing hub to drive gear. Remove nuts from pump mounting studs. Install a puller (IH tool No. FES 111-2 or equivalent) on drive gear and force pump shaft from hub. Remove injection pump.

CAUTION: Do not turn crankshaft while pump is removed.

When reinstalling pump, make certain that timing pointer in pump and timing line on face cam are aligned, then reinstall pump by reversing removal procedure. Align scribe mark on pump mounting flange with punch mark on engine front plate. Tighten nut on pump drive shaft to a torque of 48 ft.-lbs.

56. **STATIC TIMING.** To adjust static timing, first shut off fuel at tank and remove timing hole cover (6 – Fig. 49). Turn crankshaft in normal direction of rotation until number one piston is coming up on compression stroke. Continue turning crankshaft until the 16 degree BTDC mark on crankshaft pulley is aligned with the timing pointer on timing gear cover. At this time, the timing line on face cam should be aligned with the timing pointer on roller retainer ring in pump. If not, first make certain that scribe line on pump mounting flange is aligned with punch mark on engine front plate. Then, unbolt and remove rectangular cover from front of timing gear cover. Loosen the three cap screws securing pump shaft hub to drive gear. Rotate hub as required to align timing line on face cam with the timing pointer. Tighten hub retaining cap screws to a torque of 20 ft.-lbs. Reinstall timing covers.

57. **TIMING ADVANCE.** To check and adjust timing advance, remove timing cover from side of pump and install adapter and timing window (IH tool FES 504-1 and FES 111-5). With static timing line on face cam in register with timing pointer, note location of timing pointer in relation to the marks on timing window. Start engine and allow it to run until it reaches normal operating temperature. Check position of timing pointer with engine operating at 700 rpm on Model 684 or 750 rpm on Models 784, 884 and Hydro 84. Timing pointer should be at full retard (static timing) position. While slowly increasing engine rpm, observe the timing pointer advance. The pointer should start to advance at approximately 1050-1150 rpm and should reach full advance of 5.6 degrees or 1-5/6 marks at 2540 rpm on Model 684 or 5.6 to 6.5 degrees or 1-5/6 to 2-1/6 marks at 2710 rpm on Models 784 and Hydro 84 or 6.6 to 7.4 degrees or 2-1/6 to 2½ marks at 2685 rpm on Model 884.

NOTE: Each mark on the timing window is equal to 3 pump degrees.

If start of advance does not take place at specified rpm, remove advance spring cap, directly opposite from advance piston plate (7 – Fig. 49) and add or remove shims between spring and cap as required. Remove shims if advance starts too late or add shims if advance starts too soon.

INJECTION PUMP CONTROL ADJUSTMENTS

All Models

58. **LOW AND HIGH IDLE.** To adjust the low idle speed, start engine and bring to operating temperature. Move speed control lever to low idle position, loosen jam nut and turn low idle speed stop screw (8 – Fig. 49) as required to obtain an engine low idle speed of 700 rpm on Model 684 and 750 rpm on Models 784, 884 and Hydro 84. Tighten jam nut.

Move speed control lever (9) to high idle position, loosen jam nut and turn idle stop screw (2) as required to obtain an engine high idle no-load speed of 2540 rpm for Model 684, 2710 rpm for Models 784 and Hydro 84 or 2685 rpm for Model 884. Tighten jam nut.

With engine high idle speed properly adjusted, the rated load engine speed should be 2300 rpm for Model 684 and 2400 rpm for Model 784, 884 and Hydro 84. To adjust rated load rpm, use a dynamometer and load engine to maintain rated rpm with throttle control lever in high idle position. Adjust the maximum fuel stop screw (5) to obtain the following (pto) horsepower at rated rpm.

Model	Horsepower
684	62.5
784	67.4
884	72.9
Hydro 84	58.7

CAUTION: Do not overfuel the engine or attempt to increase horsepower above rated load.

59. **SHUT-OFF PLUNGER.** To adjust the shut-off plunger, disconnect the shut-off cable. Loosen the jam nut on shut-off plunger (3 – Fig. 49) and back the plunger assembly out several turns. Operate engine at low idle rpm and move fuel control lever (4) on pump counter-clockwise until engine starts to surge and intermittently emit black smoke. Adjust shut-off plunger to contact fuel control lever at this point and tighten jam nut. This is the excess fuel or starting position for the control lever. Move lever fully rearward to depress the plunger. Engine must shut off in this position at all throttle settings. Connect shut-off cable to control lever.

INJECTION NOZZLES

CAUTION: Fuel leaves the injection nozzles with sufficient force to penetrate the skin. When testing, keep your person clear of the nozzle spray.

60. **TESTING AND LOCATING FAULTY NOZZLE.** If engine does not run properly and a faulty injection nozzle is suspected, or if one cylinder is misfiring, locate faulty nozzle as follows: Loosen the high pressure line fitting on each nozzle holder in turn, thereby allowing fuel to escape at the union rather than enter the cylinder. As in checking spark plugs in a spark ignition engine, the faulty nozzle is the one that when its line is loosened, least affects the running of the engine.

Remove the suspected nozzle as outlined in paragraph 61, place nozzle in a test stand and check nozzle against the following specifications:

Opening pressure (new)	3100-3300 psi
Opening pressure (used)	2900 psi

Nozzle showing visible wetting on the tip after 10 seconds at 2700 psi is permissible. Maximum allowable leakage through return is 10 drops in one minute at 2700 psi. If nozzle requires overhauling, refer to paragraph 62.

61. **REMOVE AND REINSTALL.** To remove any injection nozzle, first remove dirt from nozzle, injection line, return line and cylinder head. Discon-

nect leakage return line and high pressure injection line from nozzle and immediately cap or plug all openings. Remove the retaining bolt and carefully withdraw the injector assembly from cylinder head.

When reinstalling, tighten injector retaining bolt to a torque of 18 ft.-lbs.

NOTE: It is recommended that cooling system be drained before removing injectors. It is possible that injector nozzle sleeve may come out with injector and allow coolant to enter engine.

62. **OVERHAUL.** To disassemble the injector, clamp flats of nozzle body (3 - Fig. 50) in a vise with nozzle tip pointing upward. Remove nozzle holder nut (10). Remove nozzle tip (9) with valve (8) and spacer (7). Invert nozzle body (3) and remove spring seat (6), spring (5) and shims (4).

Thoroughly clean all parts in a suitable solvent. Clean inside the orifice end of nozzle tip with a wooden cleaning stick. The 0.011 inch diameter orifice spray holes may be cleaned by inserting a cleaning wire of proper size. Cleaning wire should be slightly smaller than spray holes.

When reassembling, make certain all parts are perfectly clean and install parts while wet with clean diesel fuel. To check cleanliness and fit of valve (8) in nozzle tip (9), use a twisting motion and pull valve about ⅓ of its length out of nozzle tip. When released, valve should slide back to its seat by its own weight.

NOTE: Valve and nozzle tip are mated parts and under no circumstance should valves and nozzle tips be interchanged.

Install shims (4), spring (5) and spring seat (6) in nozzle body (3). Place spacer (7) and nozzle tip (9) with valve (8) in position and install holder nut (10). Tighten holder nut to a torque of 50 ft.-lbs.

Connect the assembled injector nozzle to a test pump and check opening pressure. Adjust opening pressure by varying number and thickness of shims (4). Opening pressure should be adjusted to 3000 psi if old spring (5) is used or to 3100-3300 psi if new spring is installed. Valve should not show leakage at orifice spray holes for 10 seconds at 2700 psi. Maximum allowable leakage through return port is 10 drops in one minute at 2700 psi.

ETHER STARTING AID

All Models

63. At temperatures below freezing, it is necessary that ether be used as a starting aid. To test the ether spray pattern, disconnect the ether line at spray nozzle and remove spray nozzle from intake manifold. Reconnect spray nozzle to ether tube. Press ether injection button on dash and observe spray pattern. A good spray pattern is cone shaped. Dribbling or no spray indicates a blocked spray nozzle or lack of ether pressure. Clean spray nozzle or install new can of ether as required.

To change the ether fluid container, turn knurled nut at base of the container retainer until container can be removed. Install new container in the ball and tighten retaining nut while guiding container head into position. Rotate container to be sure it is seated properly in injector body, then tighten nut to hold container firmly in position.

NOTE: In warm temperatures, ether container may be removed and a protective plug installed in injector body. DO NOT operate tractor without either the ether container or protective plug in position.

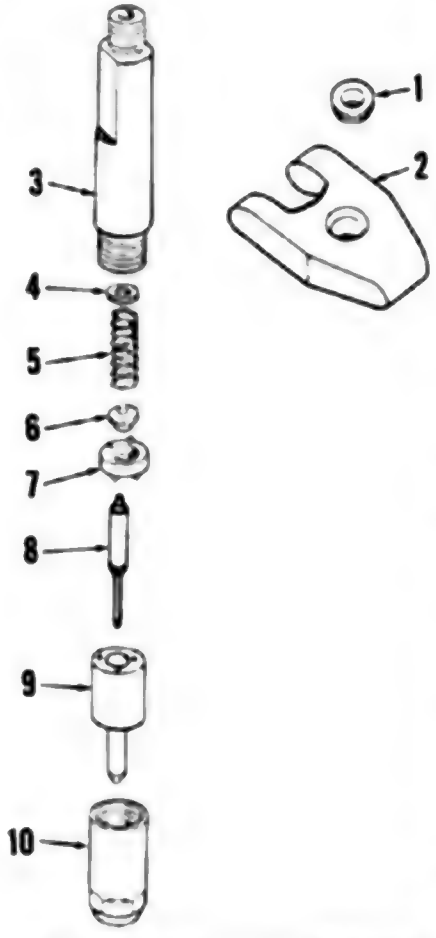


Fig. 50 - Exploded view of Robert Bosch injector nozzle assembly used on all models.

1. Washer
2. Clamp
3. Nozzle body
4. Shim
5. Spring
6. Spring seat
7. Spacer
8. Valve
9. Nozzle tip
10. Nozzle holder nut

COOLING SYSTEM

RADIATOR

All Models

64. To remove the radiator, first drain cooling system, then remove hood and front side panels. Disconnect radiator hoses, oil cooler and power steering lines. Remove air scoop. Unbolt fan shroud and move it rearward. Unbolt and remove radiator and oil cooler as an assembly.

FAN

All Models

65. The fan is attached to the water pump shaft and one belt drives the fan, water pump and alternator.

To remove the fan, loosen alternator brace mounting bolts and remove belt. Remove the four cap screws and lift out fan and spacer.

To adjust the drive belt, move alternator away from engine until a pressure of 25 pounds, applied midway between the water pump and crankshaft pulleys, will deflect the belt ¾ inch.

WATER PUMP

All Models

66. **R&R AND OVERHAUL.** To remove the water pump, first drain cooling system, then remove hood. Loosen alternator mounting bolts and remove the drive belt. Unbolt and remove fan (1 - Fig. 51), spacer (2) and pulley (3). Remove cap screws securing pump body (7) to water pump carrier. Then, remove pump from tractor.

Disassemble the pump as follows: Remove plastic screw (13), then using a ⅛ x 2 inch NC cap screw for a jack screw, force the impeller (12) off rear end of shaft. Using two screwdrivers, pry seal assembly (10) out of pump body. Support hub (4) and press out shaft. Press shaft and bearing assembly (5) out front of body. Make certain that body is supported as close to bearing as possible.

When reassembling, press shaft and bearing assembly into body using a piece of pipe so pressure is applied only to outer race of bearing. Bearing race should be flush with front end of body. Install new "O" ring (9) and seal (10). Press only on outer diameter of seal. Clean inside of pulley hub (4) and outside of shaft with degreasing solvent. Apply

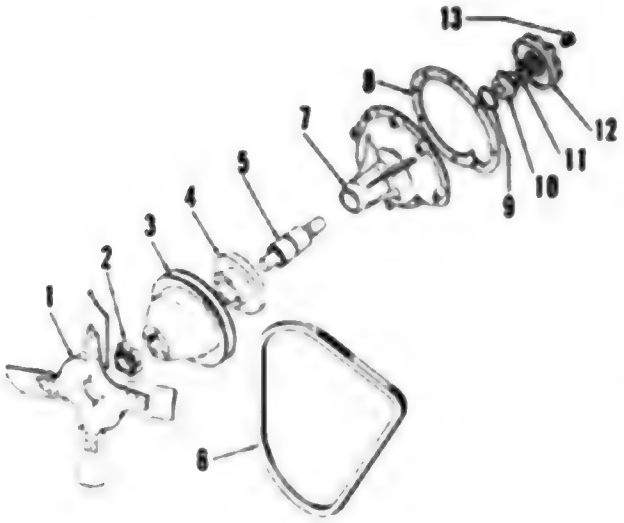


Fig. 51 – Exploded view of typical water pump assembly used on all models.
1 Fan
2 Spacer
3 Pulley
4 Hub
5 Pump shaft and bearing
6 Alternator and water pump belt
7 Body
8 Gasket
9 "O" ring
10 Seal assembly
11 Impeller face ring
12 Impeller
13 Plastic screw

a light coat of "Loctite" #601 to both surfaces. Support the shaft assembly and press hub on shaft until hub is flush with end of shaft. Install face ring (11) in impeller (12), then press impeller on shaft until there is a clearance of 0.012-0.020 inch between body and front of impeller (opposite fins). Install plastic screw.

Using a new gasket (8) reinstall pump by reversing the removal procedure. Install fan and adjust the belt as outlined in paragraph 65.

ELECTRICAL SYSTEM

ALTERNATOR AND REGULATOR

All Models

67. Lucas No. 15 ACR alternators are used on all models. A solid state regulator is mounted in end of alternator and is non-adjustable.

CAUTION: Because certain components of the alternator can be damaged by procedures that will not affect a D.C. generator, the following precautions MUST be observed.

a. When installing batteries or connecting a booster battery, the negative post of battery must be grounded.

b. Never short across any terminal of the alternator.

c. Do not attempt to polarize the alternator.

d. Disconnect all battery ground straps before removing or installing any electrical unit.

e. Do not operate alternator on an open circuit and be sure all leads are properly connected before starting engine.

Specification data for the alternator is as follows:

Lucas No. 15ACR
Field current at 80°F.:
Amperes 3.0
Volts 12.0
Rated output hot:
Amperes at rpm ..... 28 at 6000

68. **TESTING AND OVERHAUL.** The following component testing can be accomplished with minimum disassembly. Remove slip ring end cover. Note position of stator winding connections and unsolder connections from rectifier. Renew brushes if overall length is less than 5/16-inch.

Check field winding continuity and resistance simultaneously by connecting a battery operated ohmmeter as shown in Fig. 52. The ohmmeter should read 4.3 ohms for 15 ACR rotor with pink winding or 3.3 ohms for 15 ACR rotor with purple winding.

To check rotor field winding insulation, connect a 110 volt AC 15 watt test lamp as shown in Fig. 53. The lamp should not light.

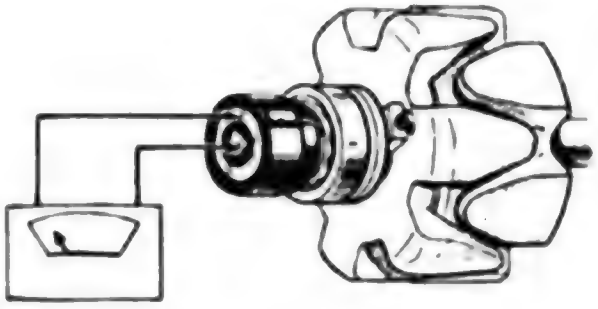


Fig. 52 – Field winding continuity and resistance test on Lucas alternator rotor. Refer to text.

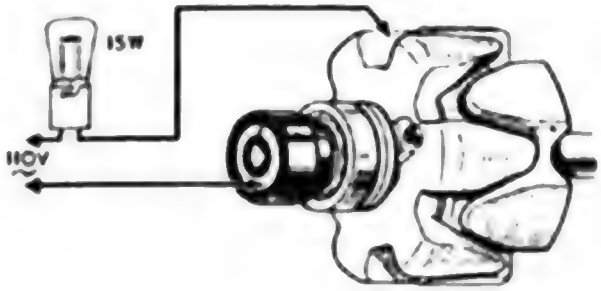


Fig. 53 – Field winding insulation check. Refer to text.

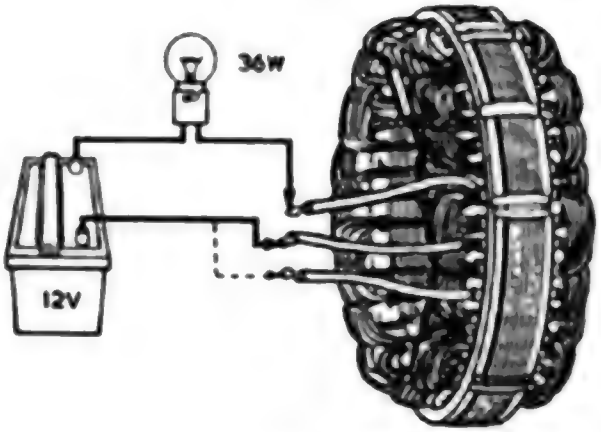


Fig. 54 – Stator winding continuity test on Lucas alternator. Refer to text.

Inner stator winding short-circuiting is indicated by signs of burning of the insulation varnish covering. If this is obvious, renew the stator assembly. To check continuity of the stator windings, connect any two of the three stator winding leads in series with a 12 volt battery and 36 watt test lamp (Fig. 54). Lamp should light. Transfer one test light lead to third stator lead. Lamp should light.

Check insulation of stator windings by connecting a 110 volt AC 15 watt test lamp between lamination and any one of the three stator leads (Fig. 55). The lamp should not light.

To test rectifier diodes, connect a 12 volt battery and 1.5 watt bulb in series as shown in Fig. 56. Reverse test connections. Lamp should light only during one half of test. If one diode is unsatisfactory, renew rectifier assembly.

Continue disassembly as follows: Scribe a mark across alternator halves (7 and 14 – Fig. 57). Remove mounting bolts and separate alternator. Separate stator (8) from slip ring end bracket. Remove drive pulley, fan and shaft key and separate rotor assembly (11) from drive end bracket. Remove snap ring, shield and front bearing assembly from drive end bracket. Unsolder field winding connections and remove slip ring (9). Press off rear bearing.

To reassemble, reverse disassembly procedure. Use only "M" grade 45-55 resin-core solder to attach wires to diode pins (Fig. 58). Tighten alternator through bolts to a torque of 55 in.-lbs.

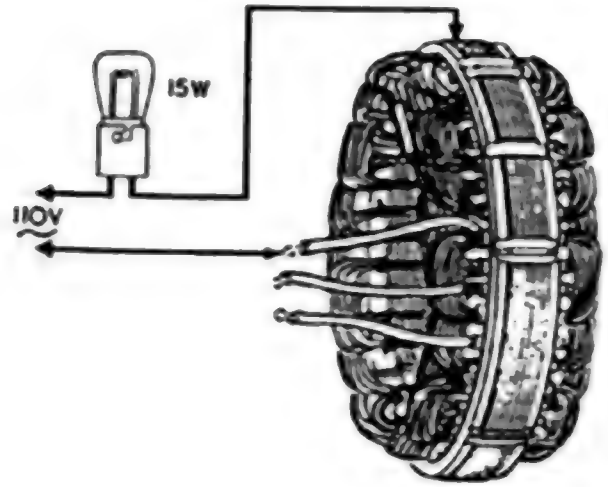


Fig. 55 – Stator winding insulation check. Refer to text.

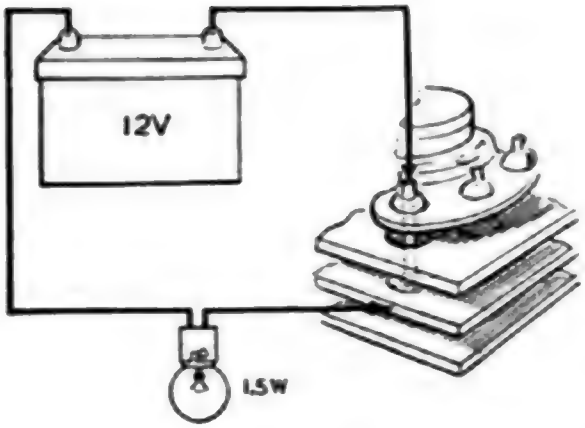
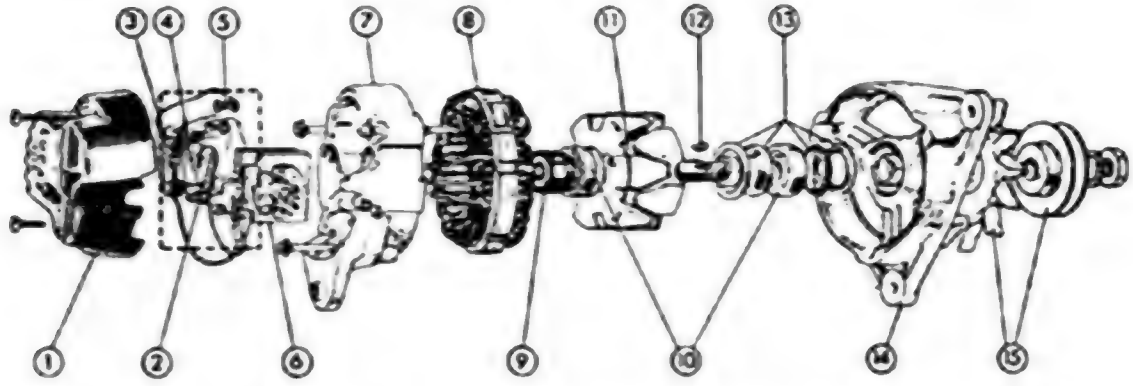


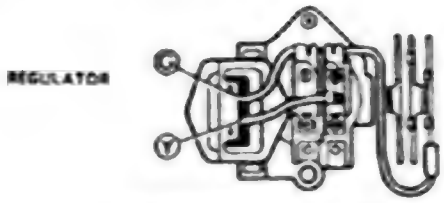
Fig. 56 – Testing rectifier diodes. Refer to text.

STARTING MOTORS

All Models

69. Delco-Remy, Bosch and Lucas starting motors are used and specification data follows:





Wiring Color Code:

G – Green Y – Yellow

Fig. 57 – Partially exploded view of Lucas 15 ACR alternator used on all models.

1. End cover
2. Brush holder assy.
3. Regulator
4. Brush and spring assy.
5. Regulator grounding and brush holder screw
6. Rectifier
7. Slip ring end bracket
8. Stator winding assy.
9. Slip ring
10. Ball bearings
11. Rotor and field winding
12. Woodruff key
13. Bearing kit
14. Drive end bracket
15. Fan & pulley

Fig. 58 — Soldering stator wires to diode pins. Use long nose pliers as a thermal shunt to avoid heat damage to diodes.

Delco-Remy Starter 1113690

Volts	12.0
No-load test:	
Volts	9.0
Amperes (min.)	75.0*
Amperes (max.)	105.0*
Rpm (min.)	5000
Rpm (max.)	7000

*Includes solenoid

Lucas Starter M-50

Volts	12.0
No-load test:	
Volts	12.0
Amperes (max.)	115.0*
Rpm (min.)	5500
Rpm (max.)	8000

*Includes solenoid

Bosch Starter 4 PS

Volts	12.0
No-load test:	
Volts	12.0
Amperes (min.)	60.0*
Amperes (max.)	90.0*
Rpm (min.)	4800
Rpm (max.)	6800

*Includes solenoid

CLUTCH

70. Gear drive Models 684, 784 and 884 are equipped with an eleven inch single plate dry disc engine clutch. Clutch wear is compensated for by adjusting clutch linkage.

ADJUSTMENT

Models 684-784-884

71. To adjust the engine clutch linkage, refer to Fig. 59 and adjust pedal free height (B) as follows: Loosen jam nut (H) and adjust screw (G) until pedal free height measures 6 inches. Tighten jam nut (H).

Loosen jam nut (D), remove pin (F) and adjust clevis (E) on clutch rod (C) until pedal free travel (A) measures 1¾ inches. Secure pin and tighten jam nut. This adjustment will provide a clearance of ⅛-inch between clutch release levers and release bearing.

Clutch linkage should be adjusted when pedal free travel has decreased to ⅛-inch.

REMOVE AND REINSTALL

Models 684-784-884

72. To remove the engine clutch, it is first necessary to detach (split) engine from clutch housing as follows: Disconnect battery cables and remove hood and rear side panels. Disconnect the tachometer cable and electrical wiring from engine and lay the cable and wiring harness rearward. Shut off fuel and disconnect fuel lines. Disconnect fuel shut-off cable at injection pump and throttle rod at right rear of engine. Unbolt and remove starter and crankcase breather. Identify and disconnect steering lines and oil cooler lines and plug openings to prevent dirt from entering system. Attach a hoist or split stand to engine and support clutch housing with a rolling floor jack. Unbolt engine from clutch housing and roll rear section of tractor from engine. Unbolt and remove clutch from flywheel.

When reinstalling the clutch, place clutch assembly over clutch shaft. Roll tractor together. Clutch can be bolted to flywheel after tractor is rejoined by working through opening at bottom of clutch housing. If flywheel and clutch plate balancing marks are indicated (dab of white paint), they must be aligned. The balance of reassembly is the reverse of disassembly procedure.

Fig. 60 — Exploded view of engine clutch assembly. Driven disc (10) is available as a unit only.

1. Release lever (3)
2. Clutch spring (3)
3. Spring cup (3)
4. Clip
5. Adjusting screw
6. Washer
7. Pin
8. Back plate
9. Pressure plate
10. Driven disc

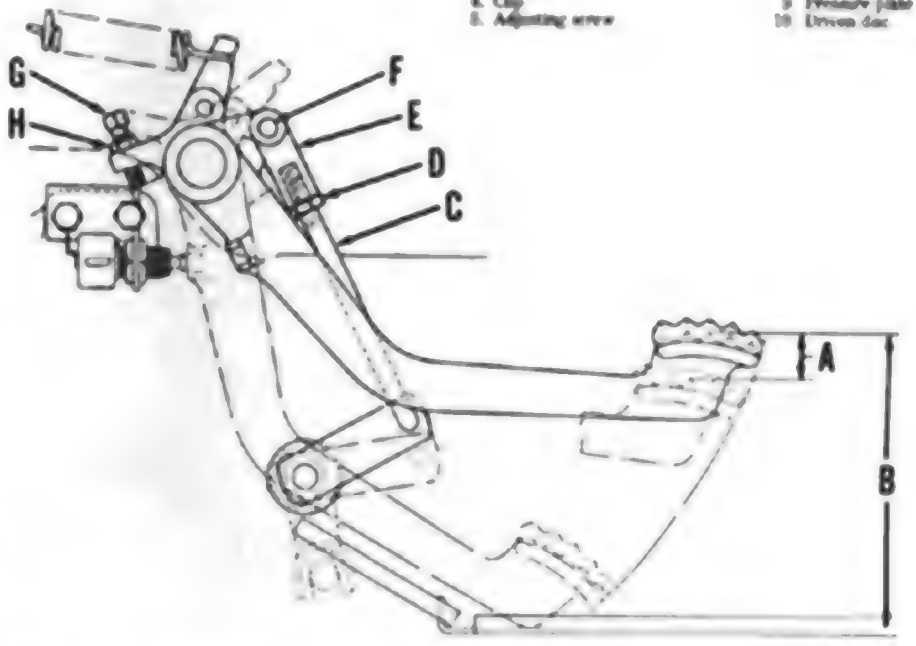


Fig. 59 — View showing the adjusting points of the engine clutch linkage on Models 684, 784 and 884. Refer to text.

A. Pedal free travel
B. Pedal height
C. Clutch rod
D. Jam nut
E. Clevis
F. Clevis pin
G. Adjusting screw
H. Jam nut

TORQUE AMPLIFIER

OPERATION

Models 684-784-884

73. The torque amplifier is a hydraulically actuated power shift unit located between the engine clutch and speed transmission. The TA is controlled by a hand lever on left side of dash panel. When shifted from direct drive to TA drive, tractor power is increased with a 17% reduction in speed in any gear without interruption of engine power. This gives the tractor a total of 16 forward and 8 reverse speeds.

In direct drive, the hydraulic applied clutch drives the unit. In TA drive, the unit is driven by a sprag clutch. The torque amplifier pump, located in bottom of housing below the TA, uses a portion of the return oil from the hydraulic oil cooler and pumps this oil to the TA regulator valve and then to the selector valve. Surplus oil from the regulator valve is returned to the differential compartment. Return oil from the clutch piston is returned to the selector valve and then dumped into the range transmission compartment.

Over-run (free wheeling) condition in direct drive is prevented by hydraulic clutch lock up and normal engine braking. Since no over-run braking is available through the sprag clutch in TA drive, a separate clutch, applied by two Belleville washers when TA drive is selected, provides engine braking.

The sprag clutch eliminates any lag in drive between disengagement of one drive and the engagement of the other.

Fig. 61—Disconnect hydraulic oil cooler return line at right front of clutch housing to install Flo-Rater to check pressure and flow of return oil. Refer to text.

TROUBLESHOOTING

Models 684-784-884

74. If there is no drive or slipping in direct drive position, make the following flow and pressure checks to determine the cause.

NOTE: Prior to making any checks on the torque amplifier hydraulic system, make certain pto and power steering systems are operating correctly.

Disconnect oil cooler return line at right front side of clutch housing as shown in Fig. 61. Connect inlet line of FES 51D Flo-Rater or equivalent, to line (1) from oil cooler. Plug remaining disconnected line (2). Place Flo-Rater outlet line into rear frame filler plughole. Make certain pto control is in fully disengaged position. Fully open Flo-Rater restrictor valve, then start and operate engine at ½-speed. Slowly close restrictor valve until a pressure of 60 psi is recorded. At this pressure, flow must not fall below 1.5 gpm. Close restrictor valve further until pressure reads 75-125 psi. At this time, there will be no flow. If the flow or pressure cannot be obtained, check adjustment of pto control lever and check operation of the oil cooler check valve. Then, recheck flow and pressure.

If flow and pressure are correct, remove the Flo-Rater and reconnect oil cooler return line. Remove plug (19—Fig. 62) from bottom of valve body (17) and install a 300 psi test gage into the test port. At rated engine speed, test gage pressure reading should be 235-270 psi. If pressure is within the range, problem is in the TA unit. Remove and overhaul unit as outlined in paragraph 76.

If pressure is not within the 235-270 psi range, remove the regulator valve from rear of valve body. A service package consisting of a new plug (23—Fig. 62), spring (20) and shims (21) is available. Add or remove shims as necessary and recheck pressure. If adjusting the regulator valve does not increase the pressure, remove the TA pump as in paragraph 75 and check for a leak or other damage.

If there is no drive in TA drive, remove and overhaul the TA unit as outlined in paragraph 76. Failure in TA drive will be mechanical.

TA PUMP

Models 684-784-884

75. **REMOVE AND REINSTALL.** To remove the torque amplifier pump, first drain the fluid from the transmission system. Remove the retaining cap screws and lower pump assembly from tractor. Hydraulic tubes (6 and 10—Fig. 62) may be removed with the pump. Remove the hydraulic tubes, then unbolt and remove pump from valve body. Lift off pump plate (15) and discard gaskets (14 and 16). Remove plug (23), shims (21), spring (20) and regulator valve. Remove nut and lockwasher from pump shaft, then remove gear (8) and key (7).

Clean all parts and renew as necessary. Pump (12) is serviced only as an assembly. Reassemble and reinstall pump by reversing the disassembly and removal procedures. Use all new "O" rings and gaskets. Fill transmission system with IH "Hy-Tran" fluid, then check and adjust TA regulator pressure as outlined in paragraph 74.

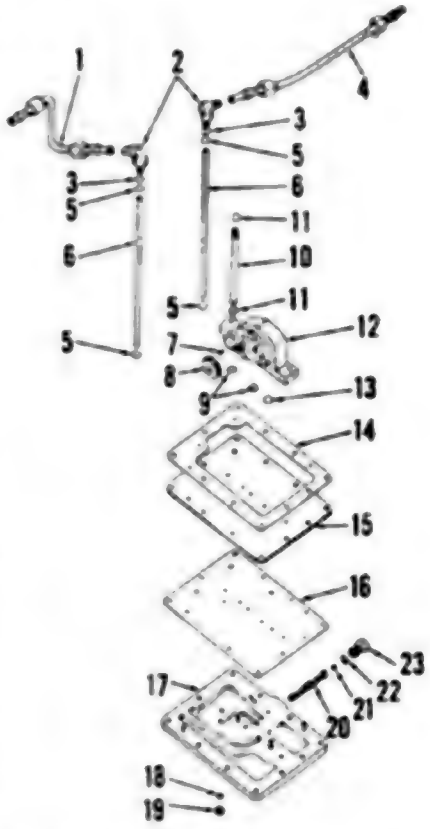


Fig. 62—Exploded view of torque amplifier pump and component parts. Regulator valve in valve body (17) is serviced only with the valve body. TA pump (12) is serviced only as an assembly.

1. Oil cooler return line
2. Elbow fittings
3. "O" rings
4. TA regulator return line
5. "O" rings
6. Oil tubes
7. Key
8. Gear
9. "O" rings
10. Oil tube to selector valve
11. "O" rings
12. TA pump
13. "O" ring
14. Gasket
15. Pump plate
16. Gasket
17. Valve body
18. "O" ring
19. Plug
20. Spring
21. Shim
22. "O" ring
23. Plug

TA UNIT

Models 684-784-884

76. **R&R AND OVERHAUL.** To remove the torque amplifier unit, first detach (split) tractor between engine and clutch housing as follows: Disconnect battery cables and remove hood and rear side panels. Disconnect the tachometer cable and electrical wiring from engine and lay the cable and wiring harness rearward. Shut off fuel and disconnect fuel lines. Disconnect fuel shut-off cable at injection pump and throttle rod at right rear of engine. Unbolt and remove starter and crankcase breather. Identify and disconnect steering lines and oil cooler lines and plug openings to prevent dirt from entering system. Attach a hoist or split stand to engine and support clutch housing with a rolling floor jack. Unbolt engine from clutch housing and roll rear section of tractor from engine.

Drain the fluid from transmission system and remove the TA pump assembly as outlined in paragraph 75. Disconnect clutch linkage rod from release shaft. Remove clutch release sleeve with release bearing. Drive out roll pins and remove release shaft and fork. Unbolt and remove the clutch housing tunnel cover and the left rear vertical panel. Shift speed transmission into third gear and disconnect shift rod from shift arm at top of cover. Disconnect wire at transmission lube pressure switch. Disconnect hose from lube tube, then remove oil lines (1 and 4 – Fig. 62). Remove snap ring from lube tube at transmission cover. Disconnect the TA shift linkage. Unbolt and remove the cover.

Unbolt and remove side pto clutch cover. Refer to Fig. 63 and drive roll pin (1) from the pto clutch and 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed). Remove lower bearing flange on rear of main frame and move 1000 rpm shaft or lower pto drive shaft rearward. Remove pto clutch assembly (4). Remove snap ring from behind gear (6), then remove the gear.

Refer to Fig. 64 and unbolt and remove pto bearing retainer cap (1). Remove snap ring from end of pto driven shaft, then bump shaft rearward out of bearing and pto driven gear. Remove driven gear through bottom opening in housing. Remove snap ring from front end of TA and speed transmission countershaft and slide TA pump drive gear and TA driven gear from countershaft.

Remove three cap screws (2) attaching input shaft bearing housing (3) to clutch housing. Then, withdraw input shafts, bearing housing and torque amplifier assembly. Remove bearing housing, pto input shaft and bearing from front end of TA input (clutch) shaft. Remove snap ring (1 – Fig. 65) from shaft (2) and slide clutch assembly (3) from shaft and bearing cage assembly. Refer to Fig. 66 and press inward on direct drive side back

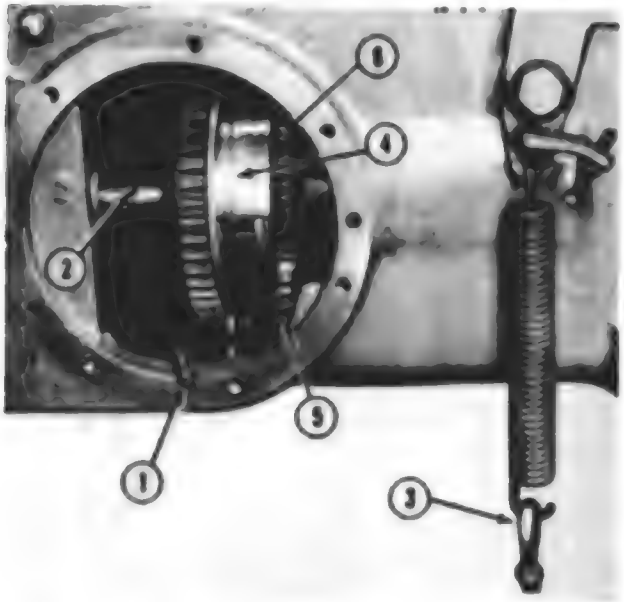


Fig. 63 – View of pto clutch, pump drive gear, lower pto drive shaft and lube pump gear on Models 684, 784 and 884.

1. Roll pin
2. Pto shaft
3. Spring & eye
4. Pto clutch
5. Lube pump gear
6. Pump drive gear

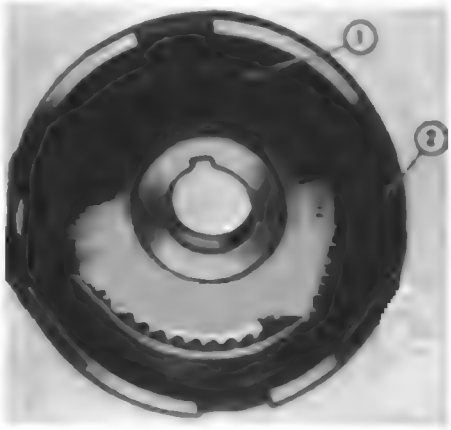


Fig. 66 – On direct drive side of TA clutch, press inward on back plate (1) and remove snap ring (2).

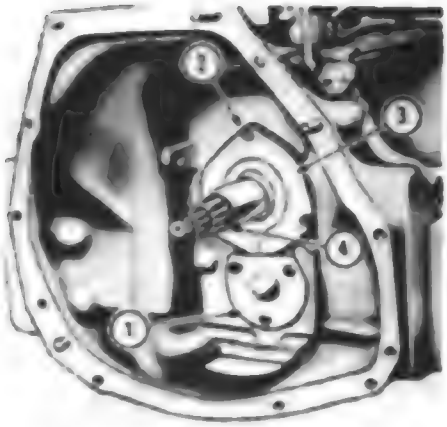


Fig. 64 – Front view of clutch housing with release bearing, fork and shaft removed.

1. Pto bearing retainer cap
2. Cap screw (3)
3. Input shaft bearing housing
4. Pto drive shaft

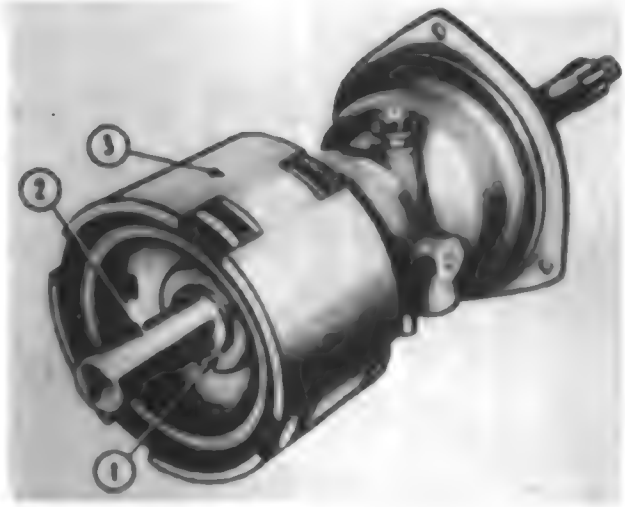


Fig. 65 – Torque amplifier unit removed from clutch housing.

1. Snap ring
2. Shaft
3. TA clutch

plate (1), then remove snap ring (2). Lift out back plate (4 – Fig. 67), three clutch discs (2), two separator plates (3) and piston back plate (1). Press inward on TA side pressure plate (1 – Fig. 68) and remove snap ring (2). Then, lift out back plate (1 – Fig. 69), two clutch discs (2), separator plate (3) and inner back plate (4). Loosen the three bolts (5) evenly until tension is removed from the Belleville washers, then remove the bolts. Separate pressure plate (1 – Fig. 70) and Belleville washers (2) from shallow side of clutch cup and the direct drive piston (3) from deep side of clutch cup. Clean and inspect all parts and renew any showing excessive wear or other damage.

Reassemble clutch as follows: Presoak new clutch discs in IH "Hy-Tran" fluid for at least three minutes before installation. Install new inner and outer seal rings (6 and 7 – Fig. 70) in grooves of direct drive piston (3). Using new bolts, install pressure plate (1) and Belleville washers (2). (Outer diameter of Belleville washers must contact pressure plate.) Then, on deep side of clutch cup, install support washers (4), piston assembly (3) and new nuts (5). Tighten bolts evenly to a torque of 5 to 6 ft.-lbs. and stake the nuts to the bolts in two places. Install inner back plate (4 – Fig. 69), clutch disc (2), separator plate (3), second clutch disc (2) and outer back plate (1). Press inward on pressure plate to compress Belleville washers and install the snap ring (Fig. 68). On direct drive side, install piston back plate (1 – Fig. 67), clutch disc (2), separator plate (3), second clutch disc (2), separator plate (3), third clutch disc (2) and outer back plate (4). Press inward on back plate (1 – Fig. 66) and install snap ring (2). Using the FES 64-7 relief valve test kit as shown in Fig. 71, check the clutch piston inner and outer seal rings for leakage. Work the hand pump to obtain a pressure reading of 240-270 psi. Pressure should hold steady if seals are good. Release the pressure and remove the test kit. Wrap clutch assembly in clean paper and lay aside for later installation.

Remove selector spool (22 – Fig. 72) from housing (23). Remove key (31) and carefully remove TA drive gear (32) and sprag clutch (33). Remove retaining ring (28), then withdraw shaft and bearing from housing. Remove seal rings (25) and snap ring (26), then press shaft from bearing (27) and remove thrust washer (29). Remove oil seals from TA housing (23). Clean and inspect all parts and renew any showing excessive wear or other damage.

To reassemble, place thrust washer (29) on shaft (30), then press bearing (27) on shaft and install snap ring (26). Fill seal ring grooves on shaft with petroleum jelly and carefully install seal rings (25). Make certain ends of seal rings are correctly locked and that rings and shaft are concentric. Install new TA input (clutch) shaft oil seal (1 – Fig. 73) in TA housing with lip of seal towards rear until seal is 0.030 inch below seal bore. Install new pto input shaft seal (2) with lip towards front until seal is flush with front of seal bore in housing. Install shaft and bearing assembly in housing (23 – Fig. 72), being careful not to damage seal rings and oil seals. Install retaining ring (28). Carefully install TA drive gear, sprag clutch and oil seal (32, 33 and 34). Check operation of sprag clutch. TA drive gear should turn free on shaft when gear is rotated in clockwise direction (viewed from splined end of shaft) and should lock-up to shaft when gear is rotated counter-clockwise. Clean and degrease shaft, keyway and clutch cup bore and apply "Loctite" to

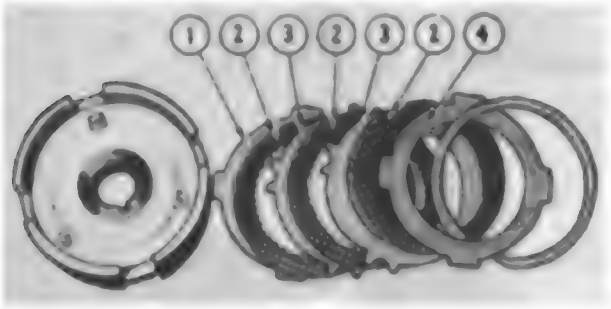


Fig. 67 – View showing components removed from direct drive side of TA clutch.
1. Piston back plate
2. Clutch discs (3)
3. Separator plates (2)
4. Outer back plate

Fig. 68 – Press inward on TA side pressure plate (1) and remove snap ring (2).

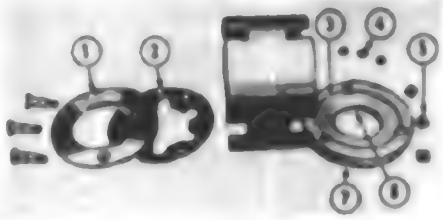


Fig. 70 – TA clutch cup with direct drive piston, pressure plate and Belleville washers removed.
1. Pressure plate
2. Belleville washers
3. Direct drive piston
4. Washers
5. Nuts
6. Inner seal
7. Outer seal

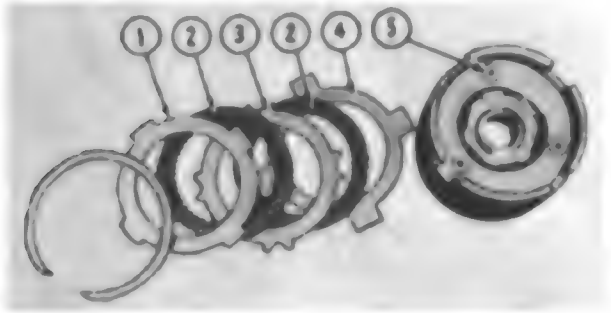


Fig. 69 – Components removed from TA side of torque amplifier clutch.
1. Outer back plate
2. Clutch discs (2)
3. Separator plate
4. Inner back plate

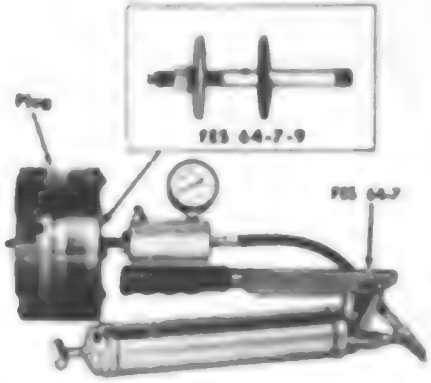


Fig. 71 – View showing IH relief valve test kit FES 64-7 being used to check piston inner and outer seals for leakage. Refer to text.

each item. Install key (31), then install clutch assembly and secure with snap ring (7). Insert selector spool (22) with collar (21) and retaining ring (20). Install the TA assembly into clutch housing. Install pto input shaft and bearing. Renew "O" ring and oil seal in the input shaft bearing housing, then install the bearing housing. Apply "Loctite" sealant to the cap screw threads and tighten cap screws securely. Install TA driven gear (42) and pump gear (43) on countershaft (40) and secure with snap ring (44). Position pto driven gear in bottom of clutch housing and move shaft forward through gear and front bearing. Install snap ring on front of shaft and using a new gasket, install the cover. Use "Loctite" on cap screw threads and tighten securely. Use new gasket and reinstall speed transmission top cover. Install TA pump assembly as in paragraph 75. Refer to Fig. 63, install gear (6) on rear of pto driven shaft and secure with snap ring. Install pto clutch assembly (4) and install 1000 rpm output shaft (dual speed pto) or lower pto drive shaft (single speed pto). Install pto lower bearing flange on rear of main frame. Drive roll pin (1) into pto clutch cup gear hub and shaft (2). Use new gasket and install side pto clutch cover. Install clutch release bearing, sleeve and fork, insert clutch release shaft and secure with roll pins. Unbolt and remove clutch from flywheel and place clutch assembly over input shafts. Roll tractor together. Clutch can be bolted to flywheel after tractor is rejoined by working through opening at bottom of clutch housing. The balance of reassembly is the reverse of disassembly procedure. Fill transmission system with IH "Hy-Tran" fluid.

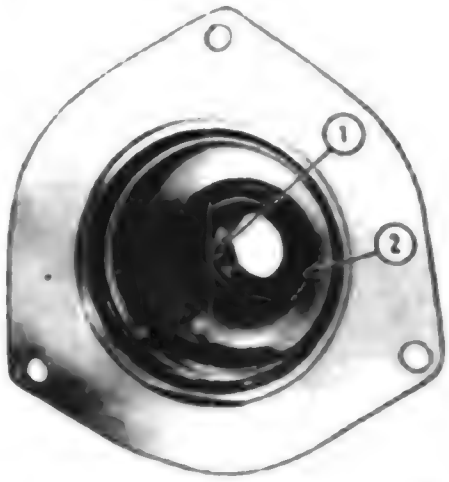


Fig. 73 – Install TA input (clutch) shaft oil seal (1) with lip towards rear and pto input shaft seal (2) with lip towards front of TA housing.

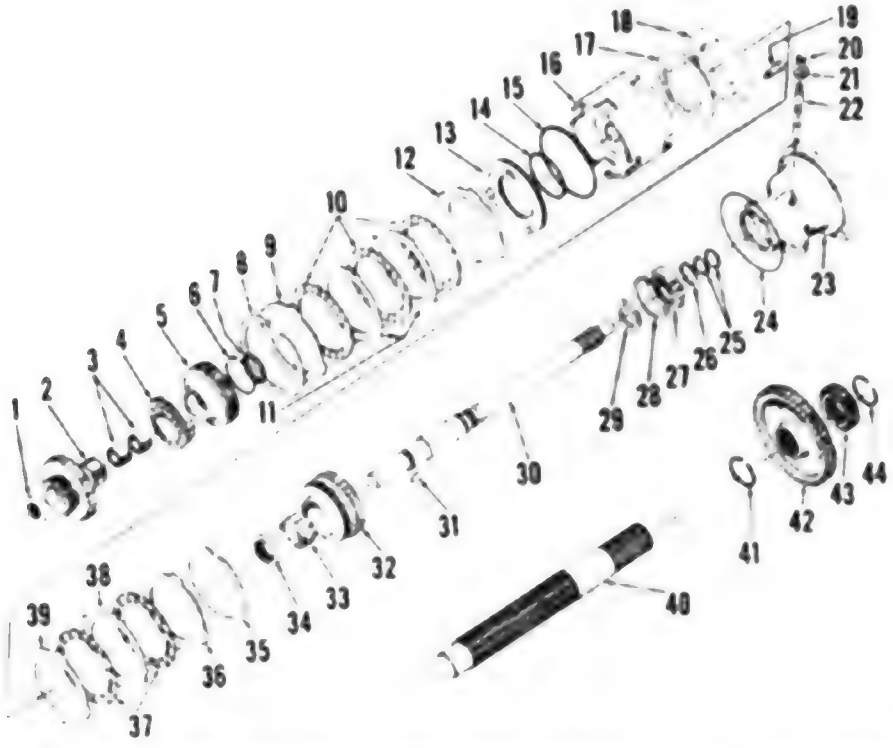


Fig. 72 – Exploded view of torque amplifier assembly used on some Model 684, 784 and 884 tractors. Items (1 through 4) are located in speed transmission.

1. Needle bearing	12. Piston back plate	23. Housing	34. Oil seal
2. Direct drive gear	13. Piston	24. "O" ring	35. Snap ring
3. Needle bearings	14. Seal ring	25. Seal rings	36. Outer back plate
4. Ball bearing	15. Seal ring	26. Snap ring	37. Clutch disc (2)
5. Clutch disc carrier	16. Clutch cup	27. Ball bearing	38. Separator plate
6. Snap ring	17. Belleville washers (2)	28. Retaining ring	39. Inner back plate
7. Snap ring	18. Pressure plate	29. Thrust washer	40. Countershaft
8. Snap ring	19. Bolt (3)	30. TA input (clutch) shaft	41. Snap ring
9. Outer back plate	20. Retaining ring	31. Woodruff key	42. TA driven gear
10. Clutch disc (3)	21. Collar	32. TA drive gear	43. Pump drive gear
11. Separator plates (2)	22. Spool	33. Spring clutch	44. Snap ring

SPEED TRANSMISSION

The synchromesh speed transmission used on Models 684, 784 and 884 is located in the clutch housing. On models equipped with torque amplifier, speed transmission is directly behind the TA. The speed transmission has been designed with synchronizers and therefore can be shifted with the tractor in motion by disengaging the clutch and applying a steady and continuous pressure to the speed lever until the shift is complete. There is no neutral position in the speed transmission as the neutral position is provided for in the range transmission.

LINKAGE ADJUSTMENT

Models 684-784-884

77. Place the speed transmission in first gear (J, Fig. 84) and the speed control lever in first gear on quadrant. Adjust control rod ends (K and L) to retain this setting.

R&R AND OVERHAUL

Models 684-784-884

78. Removal of the speed transmission requires the removal of the complete clutch housing from the tractor.

NOTE: Most of the following R&R and OVERHAUL procedures for the standard speed transmission tractors (without TA), will also apply to tractors equipped with torque amplifier and any differences in procedures will be noted.

To remove the clutch housing, disconnect battery cables and remove hood and rear side panels. Disconnect the tachometer cable and electrical wiring from engine and lay the cable and wiring harness rearward. Shut off fuel and disconnect fuel lines. Disconnect fuel shut-off cable at injection pump and throttle rod at right rear of engine. Unbolt and remove starter. Drain the transmission and differential. Remove right and left step plates, tunnel cover and differential lock pedal return spring. On top of speed transmission, disconnect the fuel line at coupler, power steering lines, lube line, TA linkage, if so

equipped and speed transmission shift linkage. Disconnect return hose at rear of brake master cylinders and the brake and clutch return springs. Unbolt and remove steering and battery mount assembly. Disconnect right and left brake lines to master cylinders. Support front and rear sections of tractor. Unbolt engine from clutch housing. Move engine section away from clutch housing, then attach hoist to clutch housing. Unbolt and remove bottom covers from clutch housing and on TA equipped models, remove TA pump as outlined in paragraph 75. Then, on all models, unbolt and remove pto bearing retainer cap (1 – Fig. 74) and the snap ring from end of shaft. Using a brass drift, tap the pto shaft out of bearing as you remove the clutch housing. Also work the pto driven gear off the pto shaft, working through the opening in bottom of clutch housing. On models equipped with torque amplifier, refer to Fig. 72 and remove snap ring (44), TA pump drive gear (43), TA driven gear (42) and snap ring (41) from front end of speed transmission countershaft (40).

To disassemble the speed transmission, disconnect clutch linkage rod from release shaft. Remove clutch release sleeve with release bearing. Tap out roll pins (3 – Fig. 74) and remove shaft (4). Unbolt and remove the release sleeve carrier (2). Remove pto drive shaft and bearing assembly (Fig. 75). Unbolt and remove transmission top cover and shift cam assembly. There are two shift cam rollers on top of shift rail. Take care not to lose the rollers. On models equipped with torque amplifier, withdraw TA unit (Fig. 65). On all models without torque amplifier, remove the pto and clutch shaft bearing housing (Fig. 81). Drive roll pin from rear shift fork making sure the pin clears the synchronizer, remove the other roll pin and remove shift rail at the rear. Remove snap ring (1 – Fig. 76) between second and fourth gears, unbolt rear bearing cage and slide main shaft out the rear. This will allow removal of the thrust washers, second gear, synchronizer and first gear. On models equipped with torque amplifier, remove snap ring (6 – Fig. 72) and clutch disc carrier (5) from front end of gear (2), then remove gear (2) with bearing (4) and synchronizer. On models without torque amplifier, remove the other gears, synchronizer and clutch shaft. Refer to Fig. 77 for location of gears and synchronizers on the main shaft.

A speed shift hub (4 – Fig. 78) is used between first and second gears and between third and fourth gears in the synchronizers. Cups (2) and synchronizer (3) are available only as an assembly.

If it is necessary to renew the ball bearing (5 – Fig. 79) on main shaft, remove the two seal rings (2), then wrap shim stock around the shaft at the seal ring grooves before removing snap ring (4) to protect the ring grooves. Be sure lube holes (1 and 3) are clean.

Remove the internal snap ring from rear of countershaft and snap ring (6 – Fig. 80) from front of countershaft. Using a brass drift, tap the countershaft rearward and remove the gears and shaft. See Fig. 72 for long countershaft (40) used on TA equipped models.

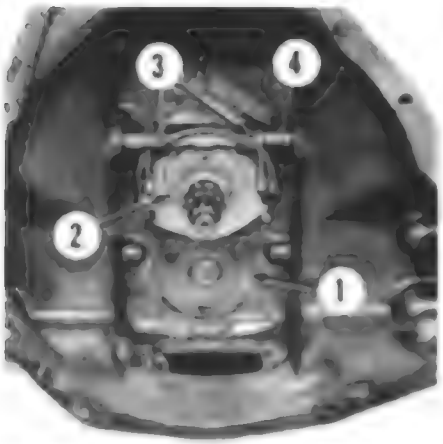


Fig. 74 – View of clutch fork and release bearing sleeve carrier.

1. Pto bearing retainer cap
2. Release bearing sleeve carrier
3. Roll pin
4. Clutch release fork shaft

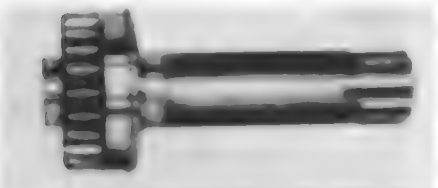


Fig. 75 – View of the pto drive shaft and bearing assembly.

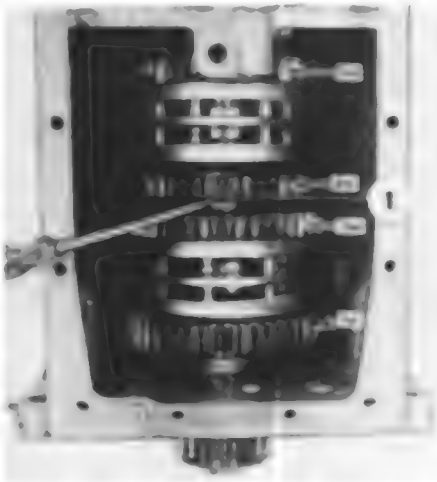


Fig. 76 – View showing removal of snap ring (1) from groove on main shaft of speed transmission. Refer to text.

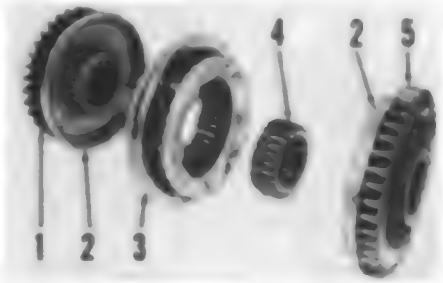


Fig. 78 – Exploded view of the synchronizer used in the speed transmission. Items 2 and 3 are available only as an assembly.

1. Gear
2. Cups
3. Synchronizer
4. Speed shift hub
5. Gear

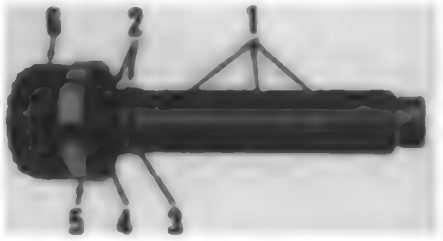
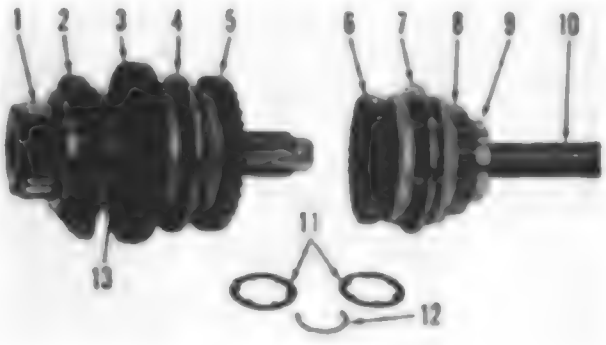


Fig. 79 – View of main shaft showing lube holes and seal rings.

1. Lube holes
2. Seal rings
3. Lube supply hole
4. Snap ring
5. Bearing
6. Main shaft

Fig. 77 – Partially exploded view showing the gears and synchronizers in correct position on mainshaft.

1. Main shaft
2. Bearing cage
3. 1st gear
4. Synchronizer (1st and 2nd)
5. 2nd gear
6. 4th gear
7. Synchronizer (3rd and 4th)
8. 3rd gear
9. Bearing
10. Clutch shaft
11. Thrust washers
12. Snap ring
13. Spacer



At this time, all parts of the speed transmission can be inspected and parts renewed as necessary. Refer to Figs. 81 and 82 for installation dimensions and information. Use new "O" rings and seals during assembly.

Reassemble by reversing the disassembly procedure, keeping the following points in mind: Lubricate all parts with "Hy-Tran" oil. Be sure when installing main shaft that a thrust washer is installed on each side of snap ring. Leave the lower front pto bearing out of the case until after the clutch housing is bolted to rear frame. When installing top cover, refer to Fig. 83, position the cam in first gear and the speed transmission in the same gear. Measure A and B on the cam and adjust the speed transmission to correspond. When installing the lower front bearing on pto shaft, first remove the pto clutch cover on right hand side of rear frame. Using a bar, hold forward on the pump drive gear while installing the bearing and snap ring.

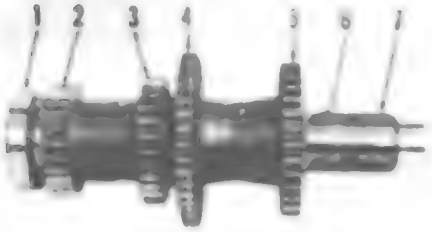


Fig. 80 – View of the countershaft with gears properly installed.

1. Bearing
2. 1st gear
3. 2nd gear
4. 4th gear
5. Countershaft
6. Gear
7. Countershaft

LUBRICATION PUMP

79. The lube pump is a 4.5 gpm capacity pump, and is located in the front of the rear section with the range transmission. The lube pump is driven by the pto and hydraulic pump drive gear assembly. The pump lubricates the main drive bevel gears and maintains proper fluid level in rear frame and speed transmission as required. Due to internal piping, pump flow cannot be checked.

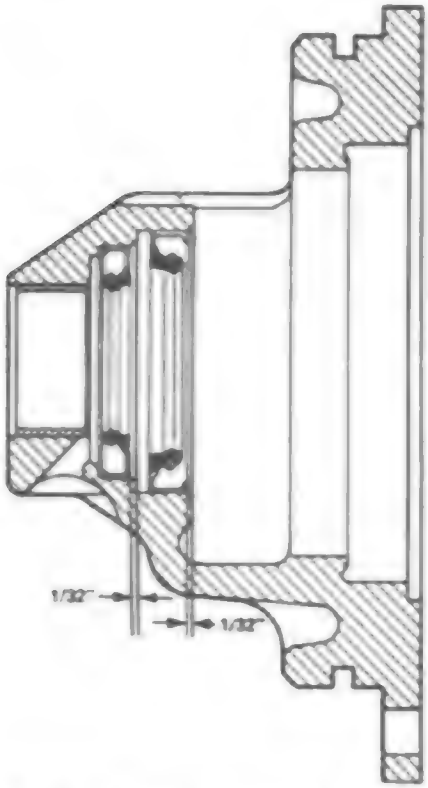


Fig. 81 – On models not equipped with torque amplifier, install oil seals in pto and clutch shaft bearing cage as shown.

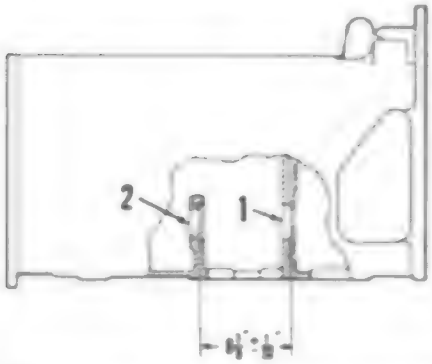


Fig. 82 – Install countershaft needle bearing (2) and pto ball bearing (1) as shown.

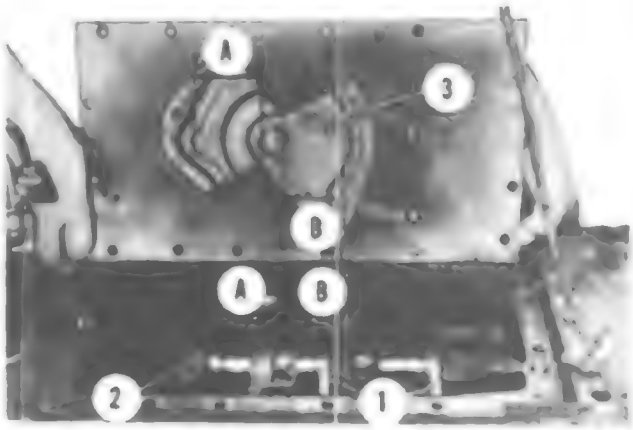


Fig. 83 – View showing the points to measure for installing the cover on the speed transmission. Refer to text.

1. Shifter fork
2. Speed shift rod
3. Shift cam assembly

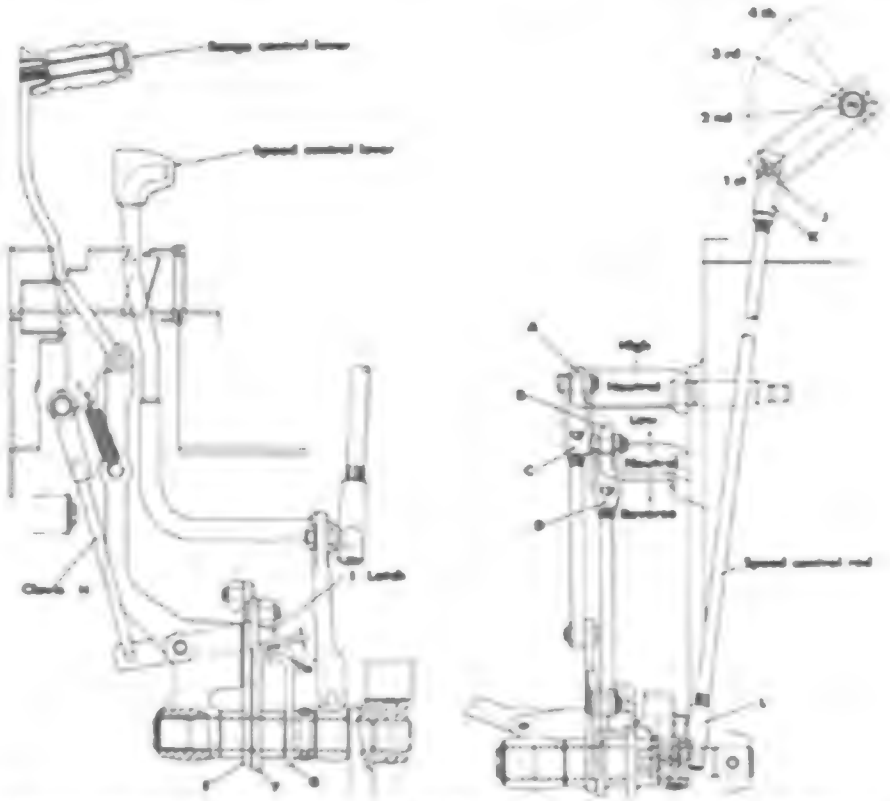


Fig. 84 – View showing the adjusting points for the speed and range transmission shift linkage on Models 684, 784 and 884.

Models 684-784-884

80. **REMOVE AND REINSTALL.** To remove the lube pump, drain "Hy-Tran" fluid from all compartments. Then, remove the multiple control valve (MCV) and hydraulic pump assembly. With MCV removed, disengage snap ring (1 – Fig. 85) and slide gear (2) to the rear. Remove the one cap screw that holds the screen assembly (5) to the pump. Remove the tube nut on line (1 – Fig. 86). Unbolt and remove pto clutch cover from right side of rear frame. Remove snap ring (4), gear (3) and set screws (5) that secure pump in position. Pull pressure tube (1) towards the MCV side enough to remove the pump.

Pump parts are not serviced separately; renew complete pump if necessary. Reinstall by reversing the removal procedure.

RANGE TRANSMISSION

81. The range transmission is located in the front portion of the tractor rear frame. On Models 684, 784 and 884, the range transmission is equipped with HI (direct drive), Lo (underdrive), neutral and reverse. On Model Hydro 84, the range transmission is equipped only with HI, Lo and neutral as reverse is provided for in the hydrostatic transmission. The band and drum type transmission parking brake is located in the range transmission on all models.

To remove the range transmission gears and shafts, the tractor rear main frame must be separated from the clutch or hydrostatic drive housing and the differential assembly removed.

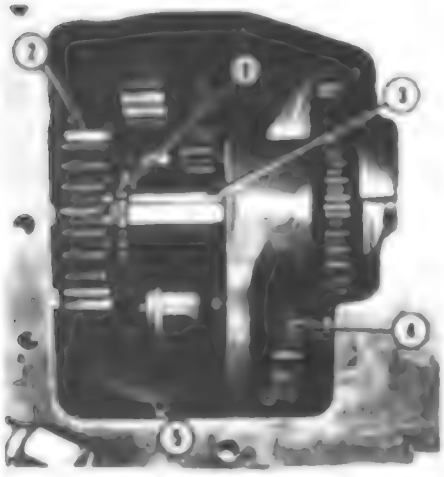


Fig. 85 – View of the lube pump on Models 684, 784 and 884 with the MCV removed.

1. Snap ring
2. Pump
3. Gear
4. Lube pump
5. Oil suction screen

LINKAGE ADJUSTMENT

Models 684-784-884

82. With range lever in neutral on the quadrant and shift arms (A and B – Fig. 84) in neutral, adjust clevises (C and D) so that slots in levers (E and F) are in alignment with stationary lever slot (G). With the range lever still in neutral, adjust clevis (H) to provide 1/16-inch clearance between latch (I) and lever (G).

Model Hydro 84

83. With range transmission in neutral, loosen jam nut and adjust clevis on shift rod until range shift lever is in register with neutral position on the shift quadrant. Check to make certain that range transmission will shift fully into Hi and Lo drive positions before shift lever contacts end of slot in quadrant.

R&R AND OVERHAUL

All Models

84. Before separating the rear frame from the clutch or hydrostatic drive housing, remove the seat, fenders and fuel tank assembly as follows:

Remove the seat, left and right side vertical covers and the tunnel cover. Disconnect wiring harness on right and left sides, fuel lines, and the park brake assembly from the left fender. Disconnect variable valve flow control line and remove control lever knobs. Remove platform and fender mounting bolts from axle housings and lift housing. Remove fenders, fuel tank and platform as a unit. Remove foot platforms. Disconnect speedometer drive cable, if so equipped.

Disconnect all necessary hydraulic lines, brake lines and wiring harness to rear frame. On Models 684, 784 and 884, disconnect speed transmission shift rod.

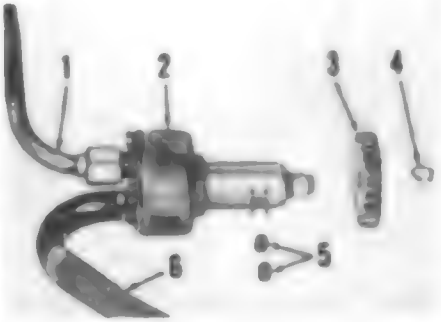


Fig. 86 – Lube pump removed from Model 684, 784 or 884. Internal parts are not serviceable.

1. Pressure line
2. Pump
3. Gear
4. Snap ring
5. Set screws
6. Screen

On all models, disconnect pto control valve linkage and range transmission linkage. Drain "Hy-Tran" oil from transmission and rear frame. Unbolt and remove hydraulic lift assembly. Attach split stand to hydrostatic drive or clutch housing and support rear frame with a floor jack. Remove rear wheels, then unbolt and remove rear axle assemblies. Remove pto clutch cover on right side of rear frame. Refer to Fig. 87 and drive roll pin from rear of clutch assembly and lower pto drive shaft. Remove the bearing cap on rear of tractor and move lower pto drive shaft (2) rearward out of pto clutch assembly. Remove clutch (4) and snap ring from rear of gear (6), then remove gear. Separate rear frame from hydrostatic drive or clutch housing. Remove the final drive planetary shafts and note that right shaft is longer than left shaft. Remove brake disc, then install screws in tapped holes of brake piston (3 – Fig. 88) and pry equally around edge with a screwdriver to remove the piston. Remove the differential lock shaft and fork.

NOTE: Shims located between arm and housing allow for proper disengagement.

Attach hoist to the differential, remove bolts (2 – Fig. 88) and install jack screws in tapped holes (4). Remove bearing retainers, keeping the shims with the retainer for reassembly. Lift the differential from rear frame.

Disassemble the range transmission as follows: Refer to Fig. 89 and disconnect brake linkage at (2), remove pin using an open end wrench (4) to support

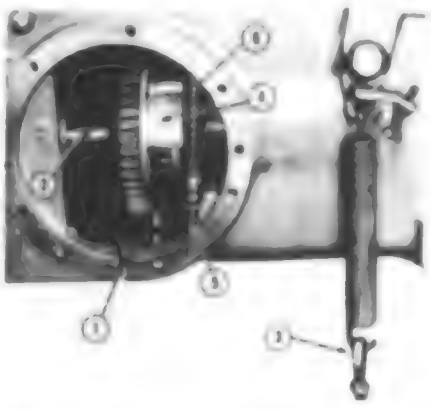


Fig. 87 – View of pto clutch, pump drive gear, lower pto drive shaft and lube pump gear on Models 684, 784 and 884. Lube pump is not used on Model Hydro 84.

1. Roll pin
2. Pto shaft
3. Spring & eye
4. Pto clutch
5. Lube pump gear
6. Pump drive gear

brake band when driving pin (5) out, then remove band. Remove shifter shaft roll pin (1), then remove shaft and shifter forks being careful not to lose poppet balls and springs. Models 684, 784 and 884 are equipped with two shifter forks and Model Hydro 84 has one shifter fork.

On Model Hydro 84, remove retaining cap screw and withdraw speedometer drive assembly (Fig. 90) from right side of rear frame. Unseat snap ring (2 – Fig. 91) from its groove in front of speedometer drive gear (11). Move speedometer drive gear forward on bevel pinion shaft and remove the steel ball (10) from under the gear. Remove snap ring (9) from its groove in front of park brake drum (8) and using a wooden block, drive brake drum forward and remove the Woodruff key (7).

On Models 684, 784 and 884, remove snap ring (1 – Fig. 92) from its groove and using a hardwood block drive brake drum (2) forward off the splines on bevel pinion shaft.

On all models, unbolt bevel pinion shaft bearing cage and remove gears and park brake drum as shaft and bearing cage assembly is withdrawn. Keep shims with bearing cage. Remove the countershaft front bearing retainer ring and unseat the snap ring to the rear of low drive gear. Drive the countershaft forward and remove the gears and spacer. On Models 684, 784 and 884, drive out roll pin (2 – Fig. 93) and remove reverse idler shaft and gear (1).

Clean and inspect all parts and renew any showing excessive wear or other damage. When renewing the bevel pinion shaft bearings, refer to Figs. 94 and 95.

On Model Hydro 84, press both bearing cups (3 – Fig. 94) into bearing cage

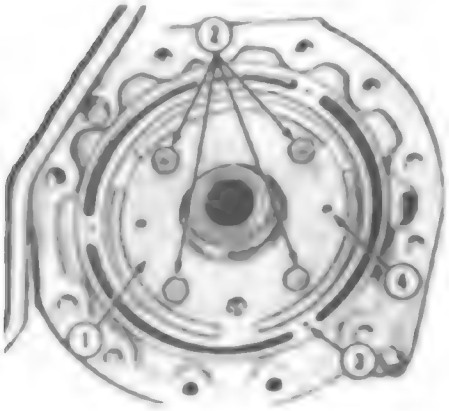


Fig. 88 – View showing screw holes for removing the brake piston and jack screw holes for removing carrier. Refer to text.

1. Carrier
2. Carrier cap screws
3. Brake piston holes
4. Jack screw holes

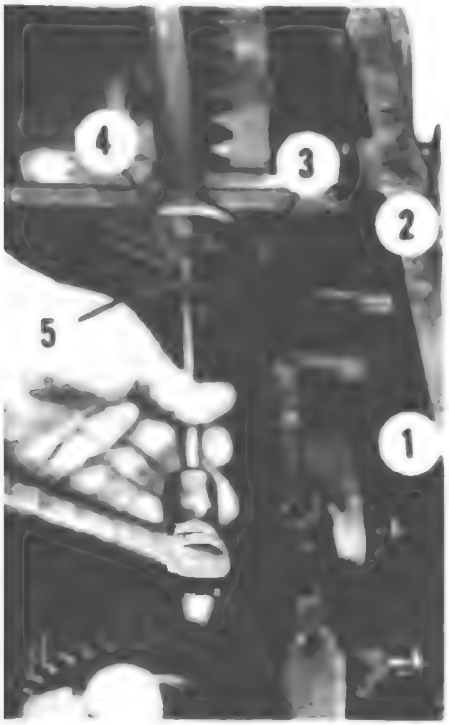


Fig. 89 – View showing procedure for removing parking brake band. Refer to text.

1. Roll pin (shifter shaft)
2. Brake linkage
3. Brake band
4. Open end wrench
5. Pin

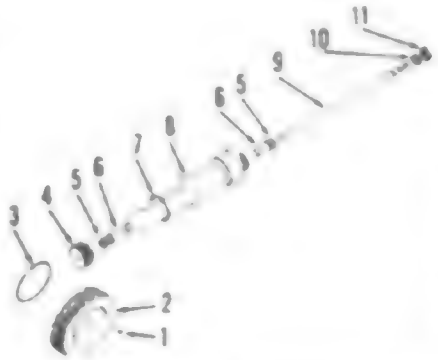


Fig. 90 – Exploded view of speedometer drive assembly used on Model Hydro 84. Items (4 through 11) are removed from right side of rear frame.

1. Steel ball
2. Drive gear
3. Snap ring
4. Driven gear
5. Thrust washer
6. Bushing
7. "O" ring
8. Housing
9. Shaft
10. Collar
11. Oil seal

Fig. 91 – Exploded view of gears, shafts and bearings used in Model Hydro 84 range transmission. Pump drive gear (26) is located on rear of lower front pto shaft.

1. Bevel pinion shaft
2. Bevel bearing cone
3. Bearing cage
4. Shims
5. Front bearing cone
6. Snap ring
7. Woodruff key
8. Park brake drum
9. Snap ring
10. Steel ball
11. Speedometer drive gear
12. Snap ring
13. Low sliding gear
14. Snap ring
15. Snap ring
16. Ball bearing
17. Snap ring
18. Constant mesh gear
19. Spacer
20. Lo range gear
21. Countershaft
22. Snap ring
23. Needle bearing
24. Needle bearing
25. Snap ring
26. Pump drive gear
27. Snap ring

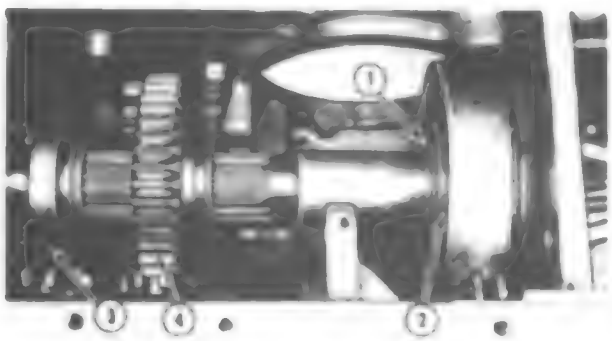


Fig. 92 – Bevel pinion shaft of range transmission used on Models 684, 784 and 884.

1. Snap ring
2. Brake drum
3. Hi range shift collar
4. Lo & reverse sliding gear

(4) until they bottom. Press rear bearing cone (5) on pinion shaft, with largest diameter toward gear, until it bottoms. Place bearing cage over pinion shaft with flange toward gear. Press front bearing cone (2) on pinion shaft and as bearing enters the cage, rotate cage to insure alignment of parts. Install snap ring (1). Support flange end of cage, tap on front end of shaft to seat front bearing cone against the snap ring. Shaft must rotate freely with 0.001-0.009 inch end play.

On Models 684, 784 and 884, bearing cups are a part of the cage (3 – Fig. 96) and pinion bearings should be set to a preload of 10 to 20 in.-lbs. of rolling torque. Press rear bearing cone (2) against shoulder on main shaft. Position cage (3) on shaft and rear bearing. Press front bearing (4) on shaft until bearing enters the cage. Lubricate bearings with "Hy-Tran" oil. Wrap a cord around O.D. of cage and attach a spring scale to end of cord. Press bearing (4) into cage until a pull of 4.5-9.0 pounds on spring scale is required to keep cage rotating. Install thrust washer (5). Select a snap ring (6) that will fit into the groove without

Fig. 93 – Countershaft in range transmission of Model 684, 784 or 884.

1. Reverse idler gear
2. Roll pin
3. Constant mesh gear
4. Spacer
5. Lo range gear

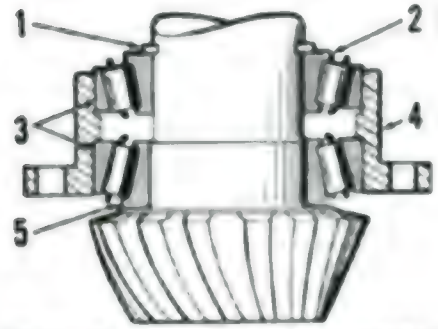


Fig. 94 – View showing bearings on bevel pinion shaft of Model Hydro 84.

1. Snap ring
2. Bearing cone (front)
3. Bearing cage
4. Bearing cage
5. Bearing cone (rear range 1 to 7)

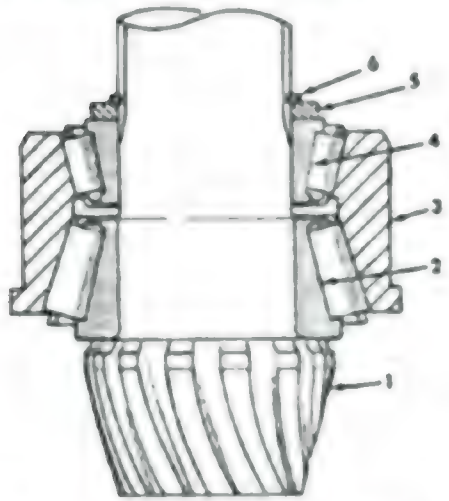


Fig. 95 – View showing bearings on bevel pinion shaft used on Models 684, 784 and 884.

1. Pinion shaft
2. Bearing cone (rear)
3. Bearing cage
4. Bearing cone (front)
5. Thrust washer
6. Snap ring (shim)

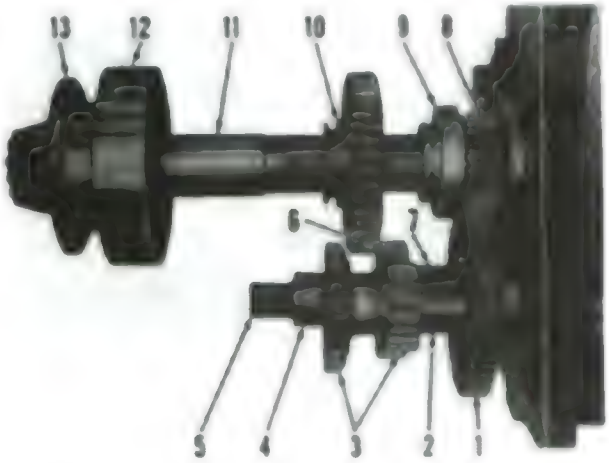


Fig. 96 – View showing location of range transmission shafts and gears used on Models 684, 784 and 884.

1. Constant mesh gear
2. Reverse idler shaft
3. Reverse idler gear
4. Countershaft
5. Pto shaft (front cover)
6. Lo range gear
7. Spacer
8. Speed transmission output shaft
9. Hi speed shift collar
10. Lo & reverse sliding gear
11. Bevel pinion shaft
12. Brake drum
13. Bearing cage

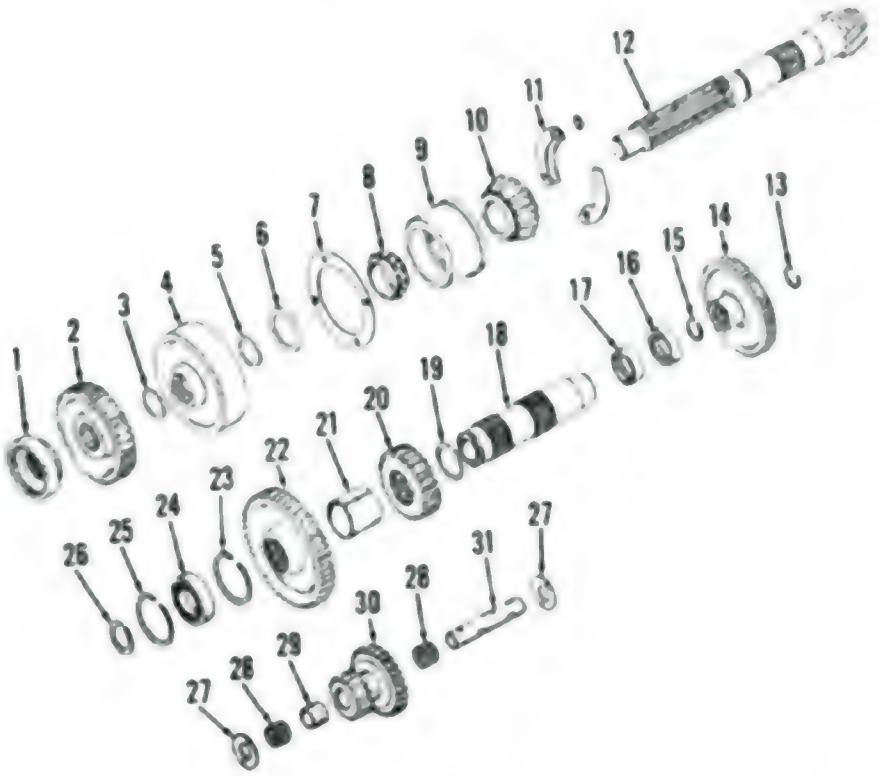


Fig. 97 – Exploded view of range transmission gears, shafts and bearings used on Models 584, 784 and 884.

1. Hi speed shift collar
2. Lo & reverse sliding gear
3. Snap ring
4. Park brake drum
5. Snap ring (shim type)
6. Thrust washer
7. Shim
8. Bearing cone (front)
9. Bearing cage
10. Bearing cone (rear)
11. Retainer
12. Bevel pinion shaft
13. Snap ring
14. Pump drive gear
15. Snap ring
16. Needle bearing
17. Needle bearing
18. Countershaft
19. Snap ring
20. Lo range gear
21. Spacer
22. Constant mesh gear
23. Snap ring
24. Ball bearing
25. Snap ring
26. Snap ring
27. Thrust washers
28. Needle bearings
29. Spacer
30. Reverse idler gear
31. Reverse idler shaft

allowing a 0.002 inch feeler gage to also go into the groove. Install the snap ring. Snap rings are available from 0.066 to 0.093 inch thickness in increments of 0.003 inch.

Using Fig. 91 or 97 as a guide, install countershaft and gears. On Models 684, 784 and 884, install reverse idler gear, thrust washers, bearings and shaft. Then, on all models, with bevel pinion shaft bearings installed adjust pinion position as follows: Install pinion shaft and bearing assembly without shims, brake drum or gears and tighten retaining bolts securely. Note the number etched on the pinion end of shaft. Install pinion gage bar tool IH No. FES 143-2 (3 – Fig. 98). Using a telescoping gage (2), measure the distance between gage bar and pinion (1). The number etched on end of bevel pinion minus 2.500 inches is the specified distance at which the pinion should be set. The difference between the specified distance and the measured distance between gage bar and pinion is the correct amount of shim thickness to be installed. Shims are available in thicknesses of 0.004 and 0.007 inch.

After determining the number of shims needed, remove pinion shaft and install shims. On Model Hydro 84, reinstall pinion assembly with shims, Woodruff key (7 – Fig. 91), park brake drum (8), snap ring (9), steel ball (10), speedometer drive gear (11), snap ring (12) and Hi-Lo sliding gear (13). Tighten bearing cage bolts securely. Install speedometer drive assembly. On Models 684, 784 and 884, reinstall pinion assembly with shims, park brake drum (4 – Fig. 97), snap ring (3), Lo and reverse sliding gear (2) and Hi speed shift collar (1). Tighten bolts through bearing cage retainers (11) securely. On all models, install shifter forks and shaft, then install brake band. Reinstall differential assembly in rear frame and check carrier bearing preload as outlined in paragraph 110 and backlash as in paragraph 113.

Complete reassembly of tractor by reversing the disassembly procedure. Bleed the brakes as outlined in paragraph 121 and adjust park brake as follows: Loosen jam nut and turn adjusting nut on linkage until park brake is fully applied when lever is pulled up 1 to 3 teeth on ratchet. Tighten jam nut.

HYDROSTATIC DRIVE

Model Hydro 84 is equipped with a hydrostatic drive which consists of a variable volume reversible swashplate axial piston pump, a variable displacement axial piston motor, a charge pump, a center section which houses the shuttle valve, relief valves and check valves, two servo cylinders, external control valves and control linkage. The pump input shaft is driven by a flex plate which is bolted to the engine flywheel. The motor output shaft drives a two-speed range transmission (paragraph 81) located in the rear frame.

TROUBLESHOOTING

Model Hydro 84

85. Some of the troubles and their possible causes which may occur during operation of the hydrostatic drive are as follows:

1. Tractor will propel itself in either direction but drive pressure is low and system is noisy. Fluid in charge circuit is aerated and fluid in auxiliary is clear.
   a. Faulty charge pump seal ring.
   b. Leak in charging circuit.
2. Tractor will propel itself in either direction but drive pressure is low and other hydraulic components (steering, hitch or auxiliary) are erratic or noisy.
   a. Low oil level.
   b. Suction line leakage.
   c. Plugged filters and by-pass screens.
3. Tractor will not propel itself in either forward or reverse.
   a. Flex plate failure.
   b. High pressure relief valve stuck open.
   c. Faulty charge pump.
   d. Foot-N-Inch valve stuck open.
   e. Manual linkage to servo cam or drive control valve disconnected.
   f. Leak in high pressure circuit or servo circuit.
4. Tractor will pull full load in one direction but will not move in opposite direction.
   a. Faulty shuttle valve in center section.
   b. Leak in loop portion of center section.
   c. Check valve leaking.
   d. Faulty drive control valve or linkage.
5. Tractor will move in reverse when Speed-Ratio lever is moved from neutral to forward position.
   a. Plugged pump servo fixed orifice.
   b. Excessive leakage at pump servo variable orifice or at "O" ring under orifice adjusting block.
6. Tractor will propel itself but lacks pulling ability.
   a. Misadjusted or faulty Foot-N-Inch valve.
   b. Leak in system check valves in center section.
   c. Excessive leakage or failure at valve plates or rotating components of drive pump or motor.
   d. Faulty drive control valve or linkage.
7. Tractor slow to change direction.
   a. Oil extremely cold.
   b. Low servo pressure.
   c. Shuttle valve binding or sticking in center section.
   d. Restriction or leaks in suction circuit.
   e. Partially plugged pump servo fixed orifice.
   f. Leak at "O" ring under pump variable orifice adjusting block.
8. Tractor will not reach transport speed but will move approximately ½-speed.
   a. Motor servo variable orifice plugged (motor swashplate stays at 18°).
9. Tractor reaches maximum speed when control lever is moved ½ to ⅔ of its travel and no change in speed occurs during the remaining lever travel.

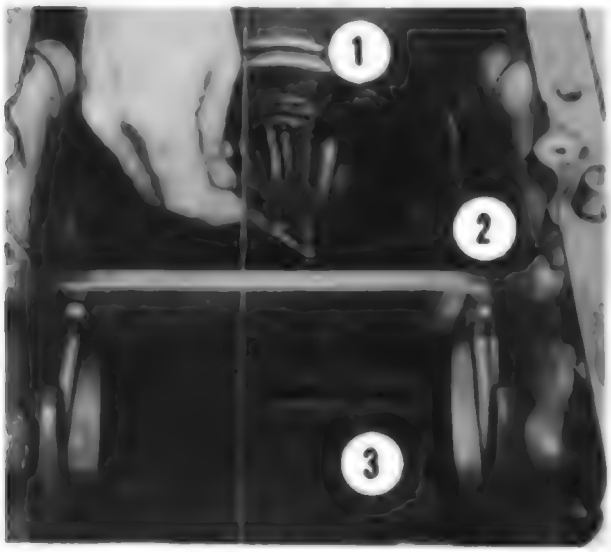


Fig. 98 – Use IH Tool No. FES 143-2 and telescoping gage when checking bevel pinion shaft setting.
1. Pinion shaft
2. Telescoping gage
3. IH Tool No. FES 143-2

a. Motor servo fixed orifice plugged.
b. Excessive leakage at motor variable orifice seal.

10. Tractor will not maintain preset speed with varying load.
a. Low servo regulator pressure.
b. Leaking piston seals in pump servo.

11. Tractor erratic in speed, will not creep but will suddenly accelerate forward.
a. Shuttle valve snap ring broken.
b. Check valve or relief valve sticking in center section.

ADJUSTMENTS

Model Hydro 84

86. **DRIVE CONTROL VALVE.** To adjust the drive control valve, first remove the tunnel cover. Then, loosen jam nut (N – Fig. 99) at each end of linkage rod (R) and adjust rod as required. Spool (S) must move a minimum of ⅜-inch inward and outward from center position when the Speed-Ratio lever is moved vertically in the zero-forward and zero-reverse position. The ⅜-inch movement in each direction is necessary to allow the check balls in control valve to seat so that drive pressure can build. Tighten jam nuts securely. Install tunnel cover.

87. **NEUTRAL ADJUSTMENT.** Raise rear wheels off the ground and support with safety stands. Remove the tunnel cover and disconnect the control cam operating rod from the cam lever (2 – Fig. 100). Unbolt and remove the cover directly ahead of the cam lever. Start engine and operate at low idle rpm and shift range transmission shift lever to Lo position. When transmission oil reaches the level of the variable orifice adjusting block on pump servo, place pto shift lever in the initial engagement position. This will allow return oil from the pto circuit to spill into range transmission and maintain a constant level in the hydrostatic drive compartment. Turn cam operating lever slowly and observe the movement of the pump servo, through the hole in the top cover. Leave the cam in the position where the pump servo does not change in length relative to cam lever movement. The movement measured at end of cam lever should be ⅝ to ¾-inch. The pin through the cam lever should be approximately in line with center line of tractor.

Move the S-R lever vertically to zero-forward and zero-reverse positions. If the pump swashplate is vertical, the wheels will have no tendency to turn in either direction. If the wheels tend to creep in either direction, pump swash plate is tilted. If so, stop the engine and loosen the two clamp bolts on the adjusting block on pump servo. If wheels creep forward, screw adjusting bolt counter-clockwise or if wheels creep rearward, screw adjusting bolt clockwise (into) adjusting block. Tighten clamp bolts and reinstall cover.

With internal neutral adjustment completed, reconnect cam operating rod to the cam lever. Start engine and operate at low idle rpm. The length of cam operating rod (3 – Fig. 100) should be adjusted so the wheels start to move when the S-R lever is moved approximately ⅛-inch in forward or reverse direction. Install the tunnel cover.

88. **FOOT-N-INCH VALVE.** The Foot-N-Inch valve is a pedal operated needle type valve located on left side of tractor. See Fig. 101. The pedal return spring holds the valve stem at the top of its bore so that maximum pressure can be held by the poppet. To adjust the valve, loosen jam nut (3) and unscrew valve stem (2) until pedal can be depressed fully to the foot plate without the valve restricting pedal movement. Hold pedal down and using a small punch in hole in stem, screw stem into linkage until stem contacts inside of valve and starts to lift pedal. Then, unscrew stem one full turn from linkage and tighten the jam nut.

89. **SAFETY STARTING SWITCH.** When the Foot-N-Inch pedal is fully depressed, the switch plunger should be depressed a maximum of ⅛-inch. Excessive movement will cause damage to the switch. The switch is adjusted toward or away from the pedal by rotating the two jam nuts on the switch.

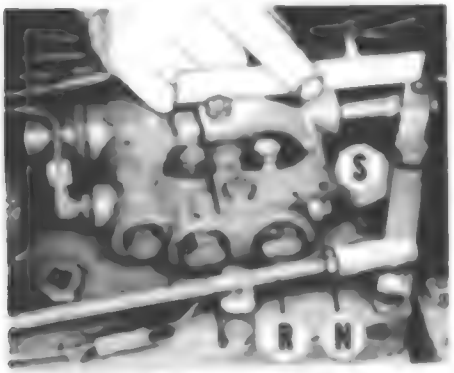


Fig. 99 – Drive control valve on Model Hydro 84. Refer to text for adjustment procedure.
N. Jam nut
R. Control rod
S. Drive control valve spool

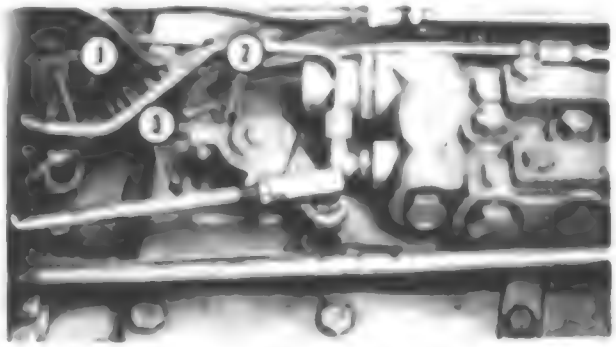


Fig. 100 – Control cam operating lever on Model Hydro 84. Refer to text.
1. Cover
2. Cam operating lever
3. Cam control rod

Fig. 101 – Foot-N-Inch valve and linkage used on Model Hydro 84.
1. Valve assembly
2. Valve stem
3. Jam nut

Fig. 102 – Test gages installed for checking drive pressure.

1. Test gage (1,000 psi)
2. Nipples
3. Connectors
4. Steel tubes
5. Elbow

PRESSURE AND FLOW TESTS

Model Hydro 84

90 **DRIVE PRESSURE.** To check the forward and reverse drive pressure support rear of tractor so both rear wheels are free to rotate. Operate tractor until transmission oil is warmed to a temperature of 135°F. Remove the tunnel cover and connect two 10000 psi test gages in the test ports of drive control valve as shown in Fig. 102. Start engine and shift range transmission to Hi position. Set engine speed at 2400 rpm. Raise the S-R lever and slowly move it forward one inch while applying both brakes.

NOTE: When applying brakes to build up drive pressure, allow wheels to rotate so that hydrostatic motor is turning. Do not stall the hydrostatic motor. Limit each high pressure test to 10 seconds.

At this point the test gage in forward drive port should read 5400-5500 psi. Move the S-R lever to neutral position, then depress lever and move it rearward one inch. Slowly apply brakes and check reverse drive pressure which also should be 5400-5500 psi.

91. **SERVO PRESSURE.** To check the servo pressure, install a 600 psi test gage in the test port above the brake pedals as shown in Fig. 103. Operate engine at a speed of 1600 rpm and check pressure which should be 390-435 psi when pump is in stroke position.

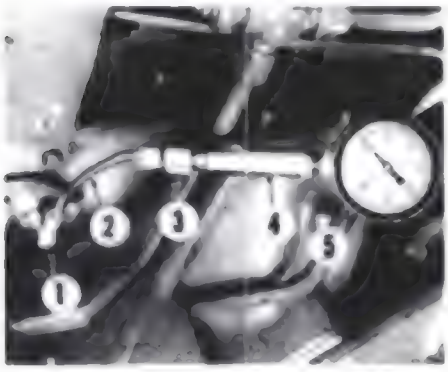


Fig. 103 – Test gage installed for checking servo pressure.

1. Elbow
2. Steel tube
3. Connector
4. Nipple
5. Test gage (600 psi)

92. **CHARGE PUMP PRESSURE AND FLOW.** Adequate charge pump pressure and flow are necessary for an efficient operation of the hydrostatic unit. To check charge pump pressure and flow, support rear of tractor so both rear wheels are free to rotate. Operate tractor until transmission oil is warmed to 135°F. Stop engine and connect a 600 psi test gage to the test port in the top of the multi-valve as shown in Fig. 104. Start engine and operate at 700-750 rpm. With the S-R lever in neutral, charge pressure should be 190-230 psi. Move S-R lever to place hydrostatic pump in stroke position and charge pressure should be 80-130 psi.

To check charge flow, connect the inlet hose of a Flo Rater to the return line from the oil cooler as shown in Fig. 105. Connect the outlet hose of the Flo Rater to the return line going to the transmission.

CAUTION: The restrictor valve on the Flo-Rater must be in wide open position at all times to prevent any build up of pressure.

Place range transmission in Hi position and block the pin in the oil cooler by-pass plug in its forward position to hold the by-pass valve on its seat. Refer to chart in Fig. 106 and with the S-R lever in neutral position, operate engine at the speeds shown. Compare the flow readings on Flo-Rater with the gpm rating on the chart.

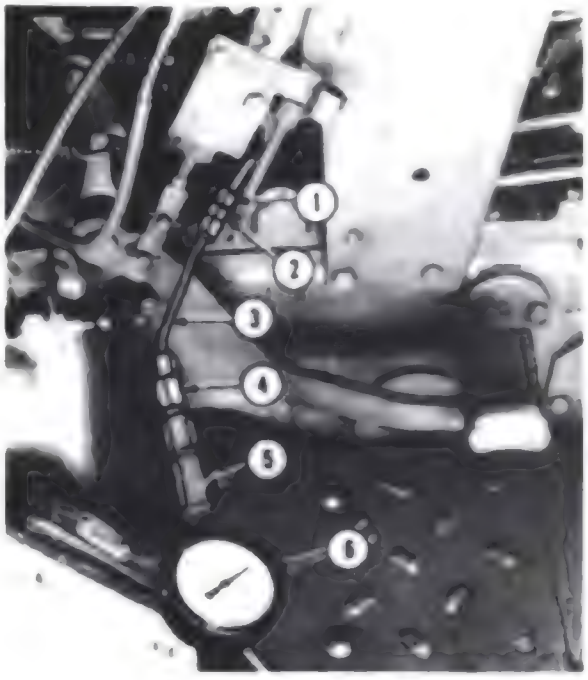


Fig. 104 – Install test gage in test port of multi-valve to check charge pressure.

1. Test line
2. Union
3. Steel tube
4. Connector
5. Nipple
6. Test gage (600 psi)

To check charge flow in forward or reverse drive, connect a 10000 psi test gage in the forward or reverse test port on top of drive control valve. With range transmission in Hi position, operate engine at 2400 rpm. Move S-R lever about one inch in forward travel position (if gage is in forward test port). Slowly apply brakes to build drive pressure between 2000-3000 psi and check charge flow reading on Flo-Rater. Reading should be slightly less in drive than the flow reading in neutral at the same rpm.

93. **DECELERATION PRESSURE.** To check the maximum deceleration pressure, support rear of tractor so both rear wheels are free to rotate. Remove tunnel cover and install a 10000 psi test gage in the reverse drive test port on drive control valve. Disconnect cam control rod from the cam lever. Start engine and operate at approximately 1500 rpm. Shift range transmission to Hi position. Turn control cam lever counterclockwise, then raise the S-R lever and move it forward 1-1⅛ inches. This will allow oil in the reverse circuit to flow under the deceleration valve. The wheels will rotate in reverse. Slowly apply the brakes and check the maximum pressure reading on test gage. Pressure reading should be 1500-2100 psi.

94. **TROUBLESHOOTING WITH PRESSURE AND FLOW TESTS.** If drive pressure is below specifications (5400-5600 psi) in either forward or reverse, or efficiency seems low, check as follows: Check and record charge pump pressure and flow in neutral at engine speeds as outlined in paragraph 92. Low charge pump pressure will indicate air in system, pump damage, leaking "O" ring or suction tube, or a faulty minimum pressure regulator valve in the multi-valve. Low charge pump flow will indicate pump damage or leakage at valve plates, bearing plates, pistons and center section which would allow charge fluid to escape from the closed loop circuit. If charge pump pressure and flow is satisfactory in neutral at the given engine speeds, connect 10000 psi test gages in forward and reverse test ports in drive control valve as shown in Fig. 102. Connect a Flo-Rater in series with oil cooler return line (Fig. 105). Then, check forward and reverse drive pressure and charge pump flow at the same time.

If drive pressure is low in both directions and charge pump flow is OK, check the following:

a. High pressure relief valve stuck open.
b. Faulty Foot-N-Inch valve or linkage incorrectly adjusted.

If drive pressure is low in one direction only and charge pump flow is OK in both directions, check for the following:

a. Faulty check valve.
b. High pressure line leak.
c. Drive control valve adjustment incorrect.
d. High pressure relief valve sticking.

If drive pressure is low in one direction only and charge pump flow is low in that direction (drive pressure and charge flow OK in opposite direction), check the following non-rotating parts:

a. Center section.
b. Valve plate.

If drive pressure is low in both directions and charge pump flow is low in both directions, check the following rotating parts:

a. Cylinder blocks.
b. Pistons and slippers.
c. Bearing plates.

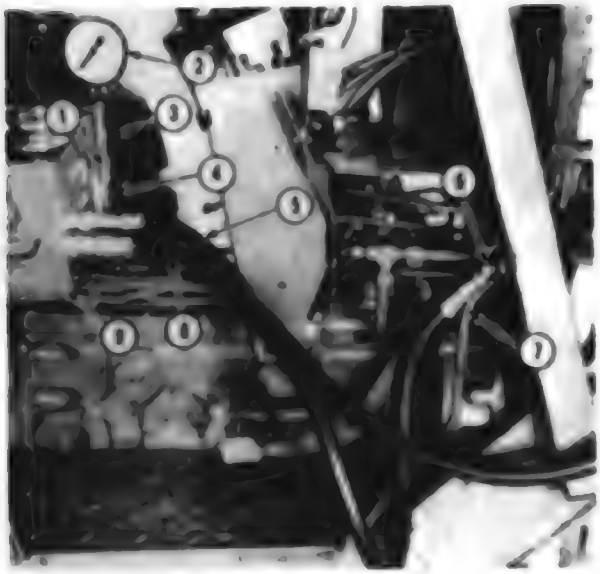


Fig. 105 – View showing Flo-Rater connected in series with the oil cooler return line when checking charge flow.

1. Converter
2. Test gage (10000 psi)
3. Shut-off valve
4. Tube
5. Outlet hose
6. Converter
7. Transmission line
8. Inlet hose
9. Flo-Rater

HYDROSTATIC DRIVE UNIT

Some components of the hydrostatic drive, other than external control valves, can be removed and serviced without removing the hydrostatic drive unit from the tractor. The control cam, variable orifices and servo cylinders can be removed after top cover is removed. The forward and reverse check valves, forward and reverse drive high pressure relief valves and the shuttle valve can be removed from the center section after removing the left and right side covers. However, if failure of these components is due to contaminated oil (dirt, water or metal particles), it is recommended that the complete hydrostatic drive system be removed and disassembled, and all components cleaned and repaired as outlined in the following paragraphs.

Model Hydro 84

95. **REMOVE AND DISASSEMBLE.** To remove the hydrostatic drive assembly, first drain the fluid from the range transmission, differential and hydrostatic drive housings. Then, split (detach) engine from hydrostatic drive housing as follows: Disconnect battery cables and remove hood and rear side panels. Disconnect tachometer cable and electrical wiring from engine and lay cable and wiring harness rearward. Shut off fuel and disconnect fuel lines. Disconnect fuel shut-off cable at injection pump and throttle rod at right rear of engine. Unbolt and remove the starter motor. Identify and disconnect power steering and oil cooler lines. Attach split stand or hoist to engine and support hydrostatic housing with floor jack or stand. Unbolt engine from hydrostatic housing and roll engine section forward from tractor.

Remove right and left foot plates and the tunnel cover. Disconnect linkage from drive control valve and cam operating lever and the speedometer drive cable. Disconnect return hose at rear of brake master cylinders. Disconnect lines from Foot-N-Inch valve. Disconnect all pedal return springs and

Charge Pump Flow in Neutral	
Engine RPM	Gallons Per Min.
2400	10.8
2000	9.0
1500	6.6
1200	4.8
900	3.6

Fig. 106 – Chart showing charge pump flow with hydrostatic drive in neutral.

the right and left brake lines. Disconnect any other electrical wiring and hydraulic lines as necessary. Unbolt and remove steering and battery mount assembly. Remove pto clutch cover on right side of rear frame. Drive the roll pin from rear of clutch assembly and lower pto drive shaft. Remove bearing cap on rear of tractor and move lower pto drive shaft rearward out of pto clutch assembly. Remove pto clutch and snap ring from rear of pump drive gear, then remove the gear. Attach a hoist to hydrostatic drive unit and support rear frame with jack or stands. Unbolt and remove hydraulic drive unit from rear frame.

Attach an engine stand to left side of hydrostatic housing and remove hoist. Unbolt and remove the multi-valve and drive control valve assemblies and lay aside for later disassembly. Refer to Fig. 107 and remove Teflon back-up rings and "O" rings from the high pressure lines. Support high pressure lines with a screwdriver, tap tube lock retainers (2 – Fig. 108) downward and remove tube locks (1) and retainers (2). Unbolt and remove the pump servo access cover. Note location of different length cap screws for aid in reassembly. Remove top cover and control cam assembly. Remove the servo pressure check cover assembly from right side of housing. Using a tie rod end tool, remove the servo regulator valve (Fig. 109). Refer to Fig. 110 and remove pump servo supply tube (4). Disconnect servo supply tube from tee (2), then remove the tube and servo regulator body as an assembly. Unbolt pump servo from swashplate and rear anchor trunnion and lift servo from housing. Unbolt and remove motor servo in the same manner. Remove the servo anchor trunnions, noting the shims under pump servo trunnion. Unbolt and remove covers from left and right sides of housing. Remove the forward and reverse high pressure lines (Fig. 111) and the elbow fittings from the relief valves.

Refer to Fig. 112 and install two ⅜ x 3 inch NC cap screws in rear bearing housing. Tighten cap screws against motor swashplate to relieve the spring load against the swashplate trunnions. Unbolt and remove trunnions with bearings and shims. Keep shims with the trunnions. Remove the cap screws securing rear bearing housing to the hydrostatic housing and carefully remove the housing, output shaft, swashplate and motor assembly.

CAUTION: Be careful not to drop the bearing plate (brass) or valve plate (steel) when removing motor assembly. Wrap plates in clean paper and set aside where they won't be damaged.

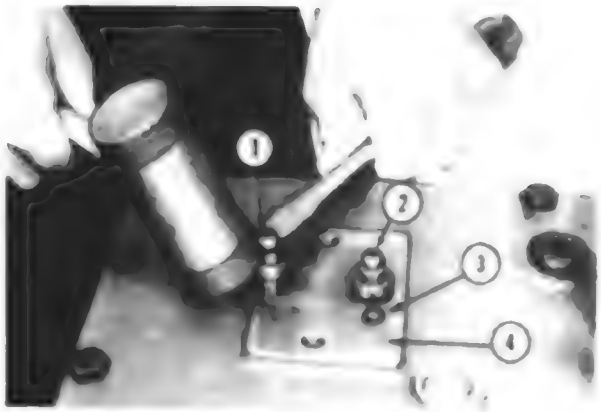


Fig. 107 – Before hydrostatic drive top cover can be removed, high pressure line retainers and locks must be removed.
1. Reverse high pressure line
2. Forward high pressure line
3. "O" ring
4. Teflon back-up ring

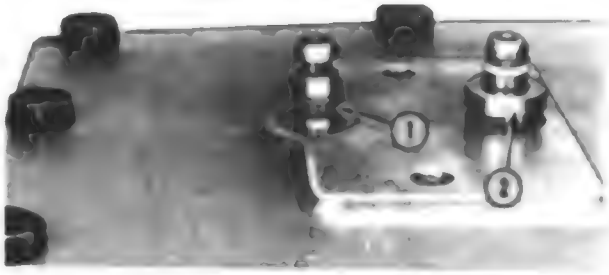


Fig. 108 – When retainers (2) are tapped downward as shown in Fig. 107, tube locks (1) are exposed for removal.

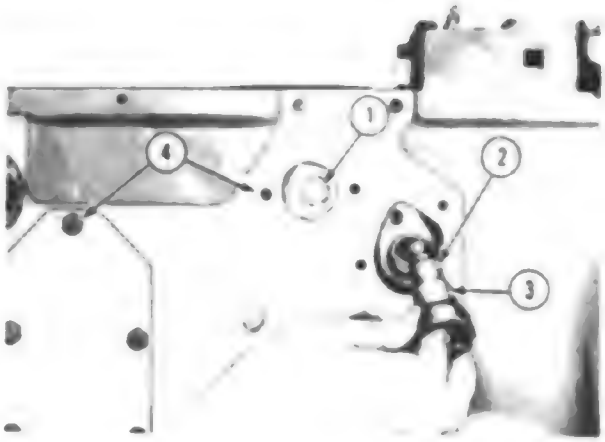


Fig. 109 – With the servo pressure check cover removed, use a tie-rod end tool and unscrew the servo regulator valve assembly.
1. Pump servo shoulder bolt
2. Servo regulator valve assy
3. Valve retainer screws
4. Location of copper washers

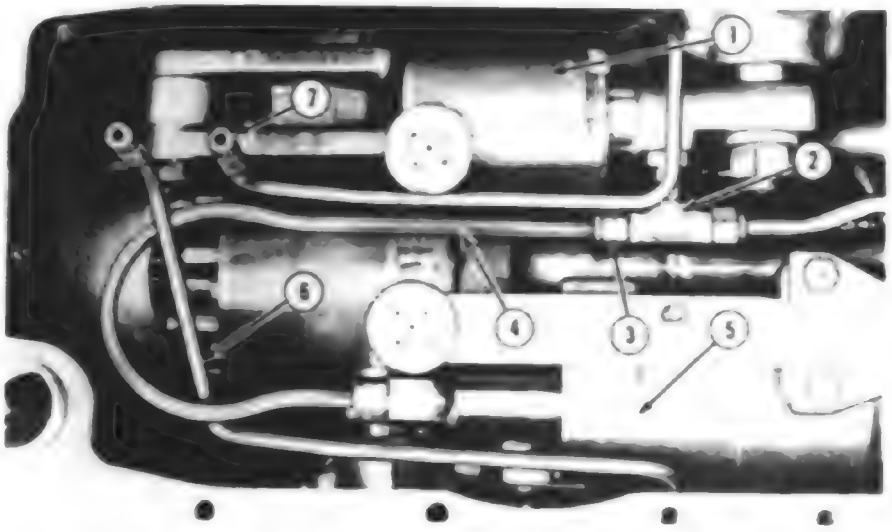


Fig. 110 – Top view of hydrostatic drive with top cover removed.
1. Motor servo cylinder
2. Servo supply line
3. Tube nut
4. Pump servo supply tube
5. Pump servo cylinder
6. Reverse high pressure line
7. Forward high pressure line

Unbolt and remove the pto front bearing retainer, "O" ring, spacer and snap ring. Remove bottom cover from housing. Attach an OTC puller No. 515-A or equivalent crossbar with two ⅜ x 2 inch NC cap screws and push pto shaft rearward out of bearings. Remove pto driven gear and snap ring through bottom opening as shaft is moved rearward. Remove bearing cups and cones.

Remove the charge pump manifold from front of charge pump. Remove the opposite two cap screws (2 - Fig. 113) which secure the suction pipe to rear of charge pump. Remove the five cap screws from outer edge of charge pump. Use three of the cap screws for jackscrews (1) and force pump outward. Carefully remove the charge pump assembly.

Unbolt retainer (3 - Fig. 115) and remove charge tube (2) and center section exhaust tube (1). It may be necessary to tap the tubes forward slightly using a screwdriver and rubber mallet. Rotate tubes to aid in removal. Unbolt and remove the hydrostatic filter assembly (Fig. 116). Then, unbolt the suction pipe (4), push the pipe into the filter compartment and separate suction elbow (2) from the pipe. Remove the elbow first, then the suction pipe.

Install horseshoe tool (1 - Fig. 117) behind the pto drive gear and tighten the cap screws against pump swashplate until spring pressure is removed from the trunnions. Unbolt and remove the trunnions, keeping the shim packs with the trunnions. Lower the pump assembly in the hydrostatic housing.

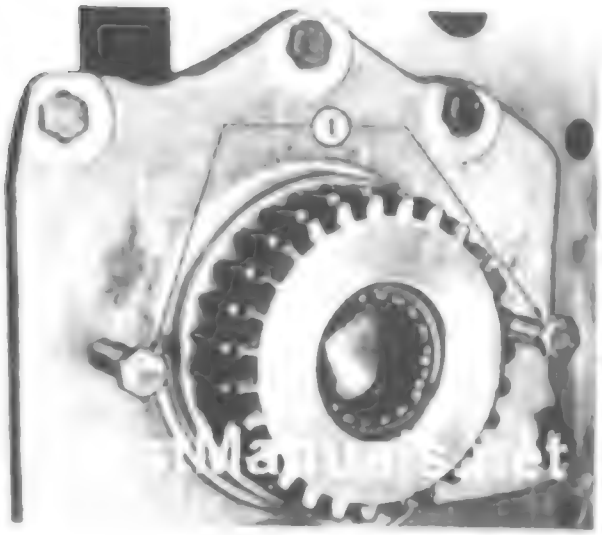


Fig. 112 – Install cap screws (1) through rear bearing housing until they contact motor swashplate to relieve spring pressure from trunnions.

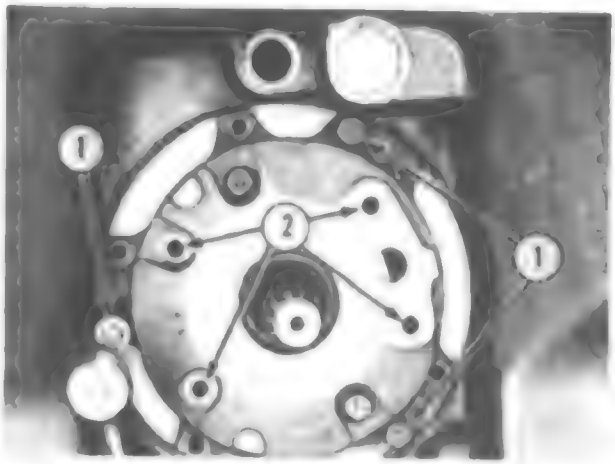


Fig. 113 – Remove cap screws (2) which attach the charge pump pressure manifold (front) and suction pipe (rear) to the pump. Use jack screws (1) to force pump forward for removal.

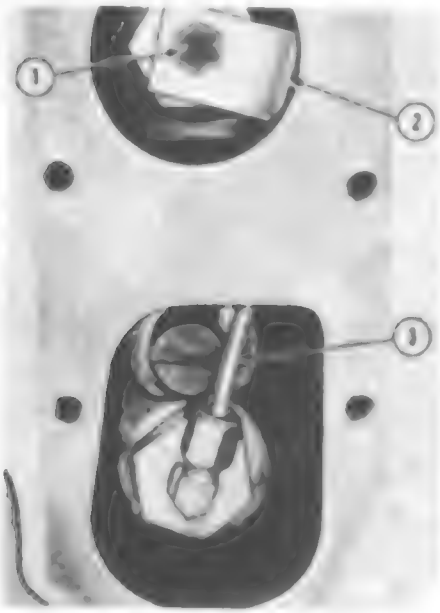


Fig. 111 – Right hand side cover removed from hydrostatic drive showing lower end of reverse high pressure line connected to relief valve in center section. Forward high pressure line is connected to relief valve on left side of center section.

CAUTION: When separating the pump from the center section, be careful not to drop the bearing plate and valve plate. Wrap plates in clean paper and set them aside where they won't be damaged.

Remove the shuttle valve spring plug and the shuttle valve retainer plug, then remove the shuttle valve spool. Wrap the spool in clean paper to prevent it from being damaged and set it aside. Unbolt and remove the center section. Lay center section on a clean protected surface to prevent the highly machined surfaces from being damaged. Then, remove the pump assembly from the housing.

96. OVERHAUL COMPONENTS. Disassemble the components, wash parts in clean diesel fuel and lubricate with IH "Hy-Tran" fluid during reassembly as outlined in the following paragraphs. Wrap each cleaned and repaired component in clean paper until time of installation.

97. CHARGE AND SERVO PUMP. The dual stage charge and servo pump furnishes approximately 10 gpm regulated between 80 psi minimum and 230 psi maximum for make-up oil, cooling and lubrication. This oil is pumped by

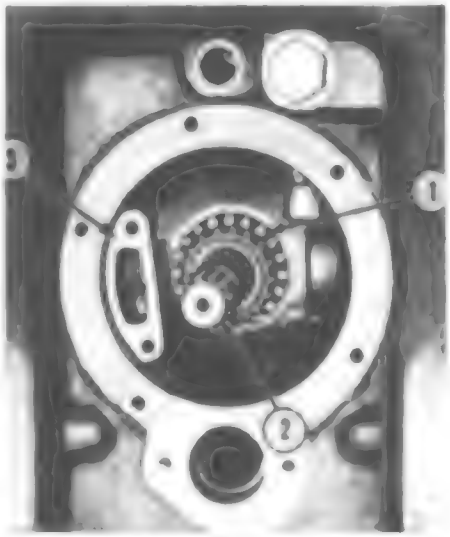


Fig. 114 – Front view of hydrostatic housing with charge pump removed.
1. Pto drive gear
2. Input shaft
3. Charge pump suction pipe

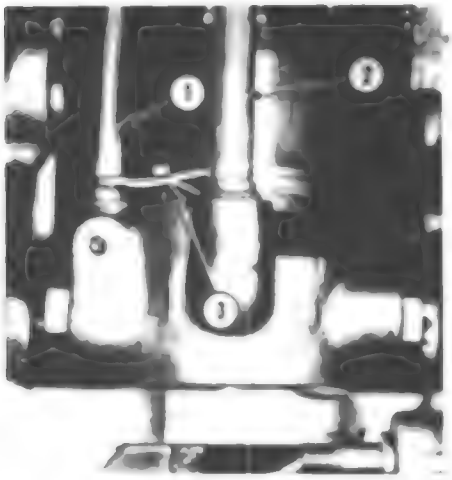


Fig. 115 – View showing charge pressure and return tubes attached to center section.

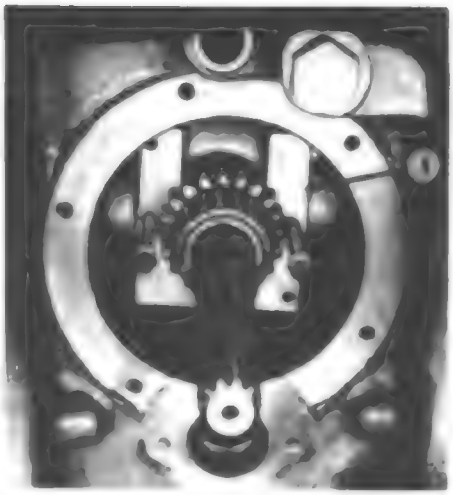


Fig. 117 – Install horseshoe tool (1) behind pto drive gear and tighten the cap screws against pump swashplate.

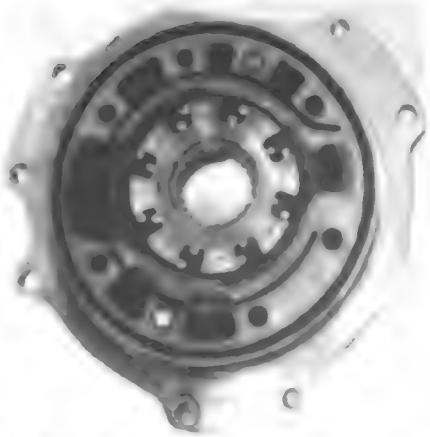


Fig. 129 – View showing rotor housing and rotor assembly correctly installed on pump body.

the slippers as they are rotated inside the rotor housing. As the slippers oscillate axially, they also pump 4 gpm regulated at a maximum pressure of 390-435 psi for the servo circuit.

To disassemble the pump, refer to Fig. 118 and remove the cover retaining cap screws. Carefully remove cover from aligning dowels, making certain that rotor assembly stays with rotor housing on pump body. Remove rotor, pins, springs and slippers from rotor housing. Lift off rotor housing which is also doweled to the pump body.

Clean and inspect all parts for excessive wear or other damage. A service package, consisting of the rotor housing, rotor, pins, springs and slippers, is available. The pump body, cover, seal rings and oil seal are available separately.

When renewing the oil seal, use OTC seal installing tool FES 123-1 or equivalent and carefully press seal into position as shown in Fig. 119. A support such as OTC step plate 611-30 must be used to support cover around center section only. When properly installed, the top of seal should be 0.508-0.518 inch from bottom (rotor side) of cover and will not be bottomed in the counterbore.

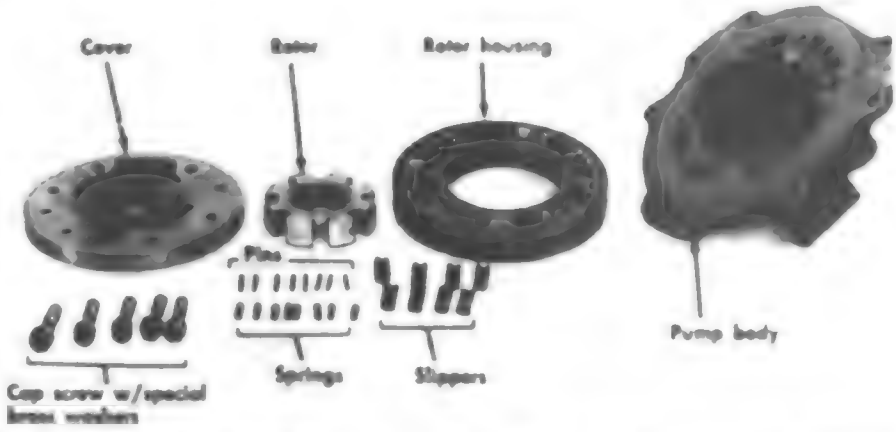


Fig. 118 – Exploded view of the charge and servo pump. Rotor housing seal rings (one used on each side) and the cover oil seal are not shown.

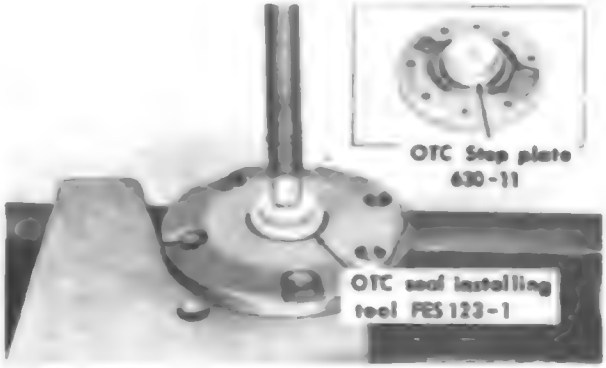


Fig. 119 – Oil seal must be carefully pressed into charge pump cover. OTC tool No. FES 123-1 should be used to install seal and OTC step plate 630-11 should be used to support the cover.

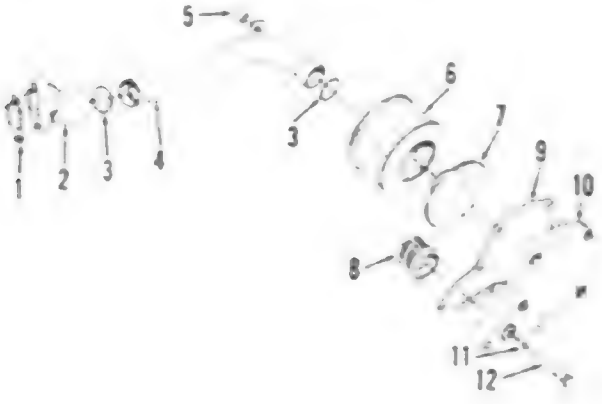


Fig. 116 – Exploded view of charge pump suction pipe and hydrostatic drive filter assembly.

1. Gasket
2. Suction pipe elbow
3. "O" rings
4. Suction pipe
5. Spacer
6. Filter element
7. By-pass valve
8. Filter shut-off valve
9. Gasket
10. Cover
11. "O" ring
12. Shut-off valve bolt

To reassemble the charge and servo pump, use new seal rings and install rotor housing on pump body. Install rotor, slippers, pins and springs as shown in Fig. 120. Pour clean "Hy-Tran" fluid around rotor and slippers and turn rotor slowly to make certain interior parts are well lubricated. Install pump cover and cap screws with brass washers. Tighten cap screws evenly to a torque of 35 ft.-lbs.

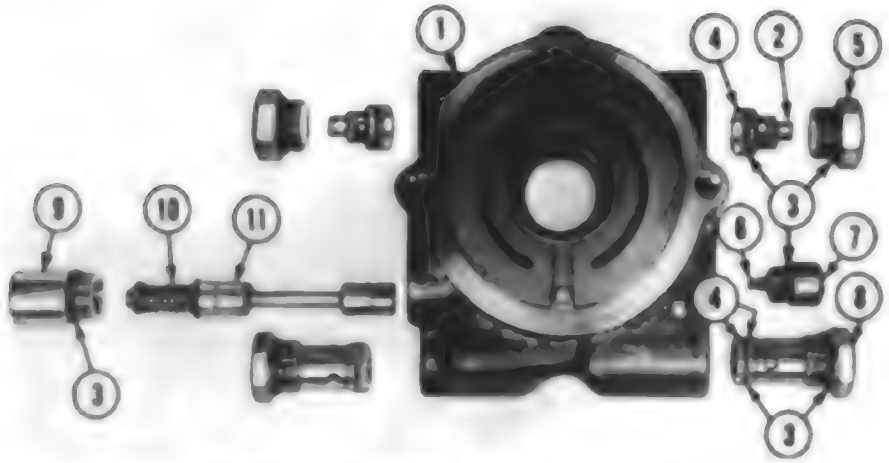


Fig. 121 – Exploded view of center section assembly.

1. Center section body
2. Check valve (2)
3. "O" rings
4. Back-up rings
5. Plug
6. Spring
7. Shuttle valve spring
8. High pressure relief valve (2)
9. Shuttle valve retainer plug
10. Centering spring
11. Shuttle valve spool

98. CENTER SECTION. The center section (Fig. 121) contains the shuttle valve, forward and reverse check valves and forward and reverse drive high pressure relief valves. To disassemble the center section, remove plugs (5) and check valves (2). Remove both high pressure relief valves (8). If not previously removed, remove spring plug (7) with spring (6) and the shuttle valve retainer plug (9). Withdraw the shuttle valve spool assembly. Remove the snap ring, washers and return spring (10) from the spool. Clean and inspect all parts. Check shuttle valve spool (11) and spool bore in body (1) for excessive wear or scoring.

NOTE: Replacement shuttle valve spools are available; however, valve spool must be matched with the same identification letter (Fig. 122) as is stamped on center section body.

Centering spring (10 – Fig. 121) should have a free length of 1-59/64 inches and should test 15 pounds when compressed to a length of 1-19/64 inches. Check valves (2) and relief valves (8) are available only as assemblies.

When reassembling, use all new "O" rings (3) and back-up rings (4) and lubricate with clean "Hy-Tran" fluid. Tighten check valve plugs (5) to a torque of 50 ft.-lbs. and tighten high pressure relief valve plugs to a torque of 20 ft.-lbs. The balance of reassembly is the reverse of disassembly.

99. HYDROSTATIC PUMP AND MOTOR. The pump and motor are of similar construction and the motor is the larger of the two units. After the input shaft and swashplate are removed from the pump and the output shaft, swashplate and rear bearing housing are removed from the motor, disassembly procedure is the same for both pump and motor.

To remove the input shaft from pump, clamp input shaft with front end downward, in a protected jaw vise. Place a protective cover on the finished (rear) end of pump. Then, using a suitable puller, remove bearing from rear of pump shaft. Invert the pump assembly and place it with the protector on wooden blocks. Remove the input shaft, horseshoe tool and swashplate with its thrust plate. Press input shaft from front bearing if necessary.

To remove the output shaft from the motor, place a protective cover on finished (front) end of motor. Using a suitable puller, remove front bearing. Position the motor assembly so that finished end with protective cover is resting on wooden blocks. Remove output shaft and rear bearing housing and the swashplate with its thrust plate. Remove the retaining ring, then press output shaft from rear bearing and housing.

To disassemble the pump or motor, grasp outer diameter of slipper retainer (1 – Fig. 123) and remove retainer with nine pistons (13). Remove ball guide (2) and withdraw six slipper retainer springs (12). Place cylinder block in a press on wooden blocks. Using a step plate on spring retainer (9), apply pressure to compress spring (5). Remove retaining ring (6), release press and remove spring retainer (9), spring (5) and spring seat (4).

Clean all parts and inspect for excessive wear or other damage. Check pistons and bores in cylinder block for linear scratches and excessive wear. Check cylinder block face for shiny streaks, indicating high pressure leakage between cylinder block and brass bearing plate. Inspect piston slippers for scratches, imbedded material or other damage. Light scratches in slippers can be removed by lapping. All nine slippers must be within 0.002 inch thickness of each other in pump or in motor.

Fig. 122 – Shuttle valve spool and center section body are stamped with matching identification letters.

1. Shuttle valve spool
2. Identification letters
3. Center section body

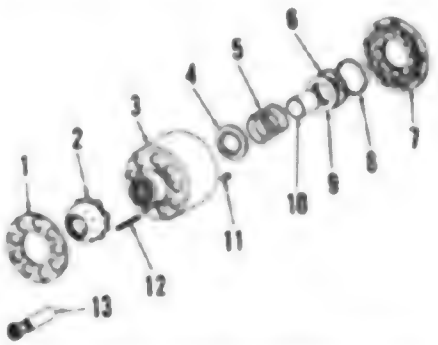


Fig. 123 – Exploded view of hydrostatic pump or motor.

1. Slipper retainer
2. Ball guide
3. Cylinder block
4. Spring seat
5. Spring
6. Retaining ring
7. Brass bearing plate
8. Centering ring
9. Spring retainer
10. Spring guide
11. Aligning dowel
12. Slipper retainer spring (6 used)
13. Piston (9 used)

Lubricate all parts with "Hy-Tran" fluid and reassemble by reversing the disassembly procedure. Spring seat (4) must be installed with beveled side away from cylinder block spring (5) and spring retainer (9) installed with retaining ring groove away from spring. When installing ball guide (2), align the wide tooth of internal splines to the two ground off teeth of internal splines on cylinder block.

With pump and motor reassembled, wrap them in clean paper and lay them aside until the swashplate trunnion bearings and the input and output shaft bearings are adjusted.

To adjust the pump swashplate bearings, install swashplate and trunnions with lubricated bearings, without "O" rings and shims. Tighten cap screws on right trunnion to a torque of 35 ft.-lbs. Tighten the three cap screws on left trunnion to 20 in.-lbs. torque while oscillating the swashplate back and forth. Then, without moving the swashplate, torque the cap screws to 35 in.-lbs. Measure the gap between the flange on left trunnion and the housing near the three cap screws. The correct shim pack is equal to the average measured gap plus or minus 0.002 inch. Shims are available in thicknesses of 0.005, 0.007 and 0.020 inch. Unbolt and remove both trunnions and the pump swashplate. Place one-half of the determined shim pack with each trunnion and lay aside for later assembly.

To adjust the motor swashplate bearings, install swashplate and trunnions with lubricated bearings and without "O" rings and shims. Tighten cap screws on right trunnion to a torque of 35 in.-lbs. Install left trunnion and tighten two opposite cap screws to 25 in.-lbs. while oscillating the swashplate. Then, without moving the motor swashplate, torque the cap screws to 50 in.-lbs. Using a feeler gage, measure the gap between the flange on left trunnion and the housing near the two unused holes. The average measured gap plus or minus 0.002 inch is the correct shim pack. Unbolt and remove both trunnions and the motor swashplate. Divide the determined shim pack equally and place shims on each trunnion. Set trunnions aside for later reassembly.

To adjust the input shaft bearings, press front and rear bearings on input shaft until bearings are seated. Install the center section with bearing cups installed and tighten retaining cap screws to a torque of 110 ft.-lbs. Rotate hydrostatic drive housing until front end is pointing upward. Place the input shaft in position. Pull the bearing cup from the charge pump housing and remove any shims present. Place 0.100 inch thickness of shims in bearing bore of charge pump, then press bearing cup into place. Place charge pump over the input shaft and install three equally spaced ⅜ x 1 inch NC cap screws. Do not use the special "Nyloc" cap screws. Tighten the three cap screws evenly to a torque of 25 in.-lbs. while rotating the shaft. Then, without rotating the shaft, torque the cap screws to 50 in.-lbs. Carefully measure the gap beside each of the three cap screws. The average gap measured should be added to 0.020 inch, then subtracted from the 0.100 inch. This will give the correct shim pack to be used. Example: Gap measured 0.045 inch plus 0.020 inch equals 0.065 inch. Subtract 0.065 inch from 0.100 inch for a shim pack of 0.035 inch. Unbolt and remove charge pump, remove bearing cup and 0.100 inch thick shim pack. Install the determined shim pack and press bearing cup into position. Shims are available in thicknesses of 0.005, 0.007 and 0.020 inch. Reinstall charge pump and tighten five retaining cap screws to a torque of 35 ft.-lbs. Using a dial indicator, check input shaft end play which should be 0.001-0.011 inch. Remove charge pump and input shaft and remove input shaft rear bearing. Install input shaft and swashplate with thrust plate on pump by reversing the removal procedure. Position the horseshoe tool between pto drive gear and swashplate with open side of tool opposite from the servo attaching ears on swashplate. With spring guide (10 – Fig. 123) and centering ring (8) installed, press input shaft rear bearing into position. Wrap assembly in clean paper and lay aside for later reassembly.

To adjust the output shaft bearings, install output shaft through rear housing and bearing. Install a 0.200 inch thick master retaining ring in groove to secure the bearing. Press shaft rearward in bearing so that bearing and retaining ring are pushed forward as far as possible on shaft. Install front bearing on shaft. Rotate hydrostatic drive housing to upright position and install output shaft assembly. Install upper right and lower left bearing housing cap screws and tighten them evenly to a torque of 25 in.-lbs. while rotating the shaft. Then, without rotating the shaft, torque the two cap screws to 50 in.-lbs. Using a feeler gage, carefully measure the gap between bearing housing and hydrostatic drive housing adjacent to the two cap screws. Subtract the average gap from 0.200 inch which will give the correct retaining ring thickness plus or minus 0.002 inch. For example: If average measured gap is 0.035 inch, subtract 0.035 inch from 0.200 inch which will give 0.165 inch as the correct retaining ring thickness. Remove output shaft assembly and install retaining ring of correct thickness. Retaining rings are available in a range of thicknesses from 0.136 to 0.186 inch in increments of 0.005 inch. Reinstall output shaft assembly and tighten the five bearing housing cap screws to a torque of 35 ft.-lbs. Using a dial indicator, check output shaft end play which should be 0.002-0.008 inch. Remove output shaft assembly and remove front bearing from the shaft. Install output shaft and swashplate with thrust plate on motor by reversing the removal procedure. With spring guide (10 – Fig. 123) and bearing plate centering ring (8) installed, press output shaft front bearing into position. Wrap assembly in clean paper and lay it aside for later reassembly.

100. VALVE PLATES AND BEARING PLATES. Inspect the steel valve plates and brass bearing plates for excessive wear or scoring in the areas shown in Figs. 124 and 125. Although bearing plates and valve plates are available separately, a valve plate and bearing plate should be renewed as a set for either the pump or motor. This will assure proper sealing between the plates

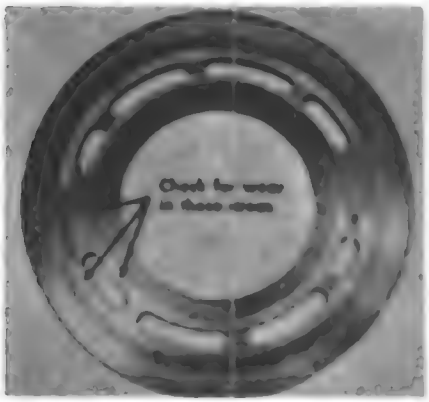


Fig. 124 – Inspect steel valve plates for wear or scoring in the areas shown.

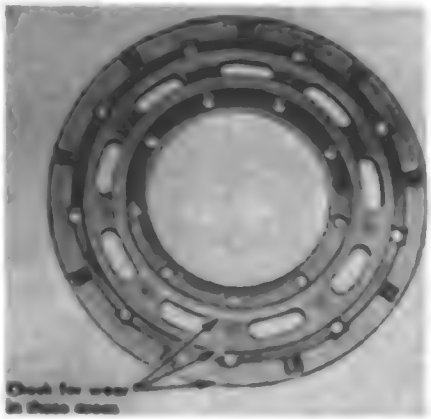


Fig. 125 – Inspect brass bearing plates for wear or scoring in the areas shown.

which is necessary for efficient operation.

101. SERVO CYLINDERS. The servo cylinders (Figs. 126 and 127) are of similar construction except for the variable orifice adjusting block used on the pump servo. Unbolt and remove clamping bracket (4 – Fig. 126) and adjusting block (3) from pump servo cylinder. Then, on either servo cylinder, clamp cylinder body (6 – Fig. 126 or 127) in a vise. Using a spanner wrench, rotate piston guide (17) and remove retaining ring (7). Remove piston guide and piston assembly from cylinder body. Slide piston guide from piston. Remove external "O" ring (14) and internal Teflon seal ring (16) and "O" ring (15) from piston guide. Remove Teflon seal ring (12) and "O" ring (11) from piston. Clamp flat sides of piston in a brass jawed vise and remove fixed orifice plug (8) and orifice screen (9).

Clean and inspect all parts. Check servo cylinder body and piston for scoring and renew as necessary. Renew all "O" rings and Teflon seal rings and reassemble by reversing the disassembly procedure. Heat new Teflon seal ring (12) in hot water (200°F.) before installing. After Teflon seal ring is installed, it will be stretched slightly. A hose clamp or piston ring compressor can be used to compress the seal ring to its original diameter.

102. CONTROL CAM AND VARIABLE ORIFICES. Inspect the control cam plate for excessive wear, scoring or other damage. The cam plate must be straight and smooth as it controls the flow through the variable orifices. The face of the variable orifices must also be free of scratches and burrs. A Teflon seal ring and a wave (spring) washer are used on the stem of each variable orifice.

103. **REASSEMBLE AND REINSTALL HYDROSTATIC UNIT.** To reassemble the hydrostatic drive unit, make certain the housing is thoroughly cleaned and proceed as follows: Rotate hydrostatic housing so that front end is pointing downward. Apply a coat of petroleum jelly on pump cylinder block and stick bearing plate in position over dowel pin and centering ring. Install pump assembly into housing and let the assembly rest in housing. With bearing races installed in center section, use petroleum jelly and stick pump valve plate in position over dowel pin. Carefully install center section assembly and tighten retaining cap screws to a torque of 110 ft.-lbs. Hold pump assembly and rotate hydrostatic drive housing to a horizontal position. Place pump in position against center section and adjust screws in horseshoe tool until trunnion bearing cups in swashplate are aligned with trunnion holes in housing. Lubricate new "O" rings and install trunnions with the previously determined shim packs. Tighten trunnion cap screws to a torque of 35 ft.-lbs. Remove the horseshoe tool.

If removed, install check valves, relief valves and shuttle valve in center section as outlined in paragraph 98. Use petroleum jelly to stick motor valve plate to center section and bearing plate to motor cylinder block. Install motor assembly, using five new "Nyloc" cap screws. Tighten cap screws to a torque of 35 ft.-lbs. Install two ⅝ x 3 inch NC cap screws in rear bearing housing. Tighten cap screws against motor swashplate until trunnion bearing cups in swashplate are aligned with trunnion mounting holes in housing. Lubricate new "O" rings and install trunnions with the previously determined shim packs. Tighten the "Nyloc" cap screws securing trunnions to a torque of 35 ft.-lbs. Remove the two cap screws from rear bearing housing.

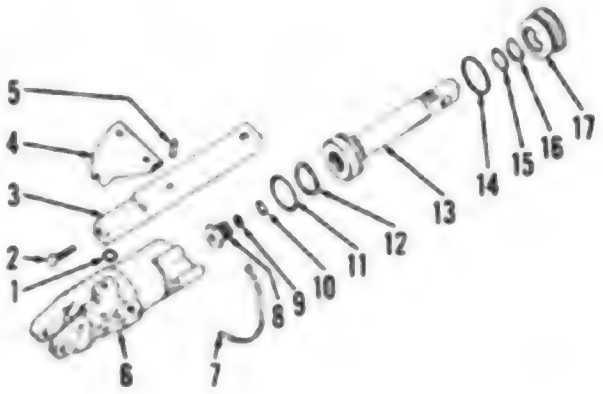


Fig. 126 – Exploded view of pump servo cylinder assembly.

1 "O" ring
2 Adjusting bolt
3 Adjusting block
4 Clamping bracket
5 Dowel pin
6 Cylinder body
7 Retaining ring
8 Fixed orifice plug
9 Orifice screen
10 "O" ring
11 "O" ring
12 Teflon seal ring
13 Piston
14 "O" ring
15 "O" ring
16 Teflon seal ring
17 Piston guide

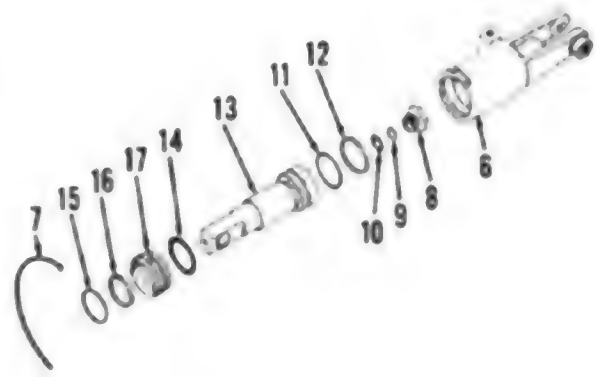


Fig. 127 – Exploded view of motor servo cylinder assembly.

6 Cylinder body
7 Retaining ring
8 Fixed orifice plug
9 Orifice screen
10 "O" ring
11 "O" ring
12 Teflon seal ring
13 Piston
14 "O" ring
15 "O" ring
16 Teflon seal ring
17 Piston guide

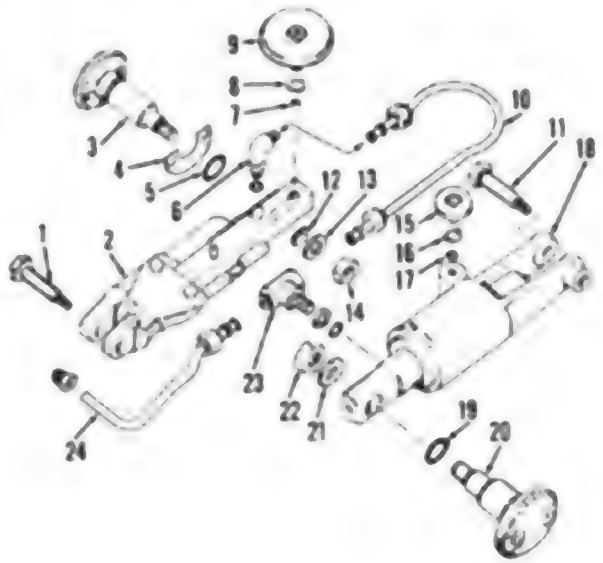


Fig. 128 – Servo cylinders, supply tubes, orifices and attaching bolts and trunnions. Note the half shims (4) used on pump servo trunnion (3).

1 Shoulder bolt
2 Pump servo
3 Pump servo trunnion
4 Half shim
5 "O" ring
6 Elbow
7 Teflon seal ring
8 Wave washer
9 Pump servo variable orifice
10 Pump servo tube
11 Shoulder bolt
12 Wave washer
13 Flat washer
14 Nut
15 Motor servo variable orifice
16 Wave washer
17 Teflon seal ring
18 Motor servo
19 "O" ring
20 Motor servo trunnion
21 Flat washer
22 Nut
23 Tee
24 Servo supply tube

Using new "O" rings, install charge pump suction pipe and elbow in housing, but do not tighten mounting bolt at this time. Lubricate new Teflon seal rings on center section charge and exhaust tubes, install tubes and secure them to center section with retainer and cap screws. Thread two ⅜ x 6 inch NC dowel pins into charge pump suction elbow and place new gasket over the dowel pins. Lubricate new "O" ring and install charge pump assembly. Rotate input shaft to align splines. Install and tighten the five new "Nyloc" cap screws retaining charge pump to a torque of 35 ft.-lbs. Remove one dowel pin from suction elbow and install cap screw, then remove other dowel pin and install second cap screw. Tighten these two cap screws and the previously installed third suction pipe cap screw securely. Using new "O" rings and Teflon seal ring, install servo regulator valve and body with servo supply tube. Tighten regulator valve to 18 ft.-lbs. torque being careful not to bend the supply tube.

Install motor servo (18 – Fig. 128), using new "O" ring (19). Tighten servo to swashplate shoulder bolt (11) to a torque of 85 ft.-lbs. Bolt trunnion (20) to housing, install washer (21) and nut (22), then tighten nut to a torque of 42 ft.-lbs.

Install pump servo (2), with new "O" ring (5) and tighten servo to pump swashplate shoulder bolt to a torque of 42 ft.-lbs. Do not install shims (4) at this time. Install wave washer (12), flat washer (13) and nut (14). Bolt trunnion (3) to housing and tighten nut (14) to a torque of 15-20 ft.-lbs. Then, unbolt trunnion from housing and place a ⅜-inch pin into hole for pump variable orifice. Using a depth micrometer set at 3.243 inches, hold servo to this distance between edge of pin and the machined surface for the trunnion (on housing). See Fig. 129. Using a feeler gage, measure gap between trunnion flange and housing. This gap is the correct shim pack required. Install the half-shims (4 – Fig. 128) and tighten trunnion retaining cap screws to a torque of 35 ft.-lbs. Then, tighten trunnion nut (14) to a torque of 42 ft.-lbs. Recheck the 3.243 inches measurement and if satisfactory, remove the pin from variable orifice hole.

Connect servo supply tubes (10 and 24) and using new Teflon seal rings (7 and 17), install variable orifices (9 and 15) with wave washers (8 and 16). Install elbow fittings in center section relief valves, then install forward and reverse high pressure lines.

Using all new gaskets, install top cover and cam assembly and all side covers. Install new "O" rings and back-up rings on forward and reverse high pressure lines and secure lines with tube locks and lock retainers. Install new filter element and install filter by-pass and cover.

Rotate hydrostatic housing to upside-down position. Install new pto shaft seal and install bearing retaining housing ring, if removed. Carefully put pto shaft through the seal and install gear retaining ring. Slide shaft forward and install pto driven gear with machined hub face (step cut) forward. Using a ½ x 6 inch NC full thread cap screw and spacer, pull pto shaft into front bearings. Remove cap screw and install bearing retaining snap ring. To adjust bearing preload, place a master spacer FES-123-11 under front pto cover and tighten the two cap screws to a torque of 20 in.-lbs. while rotating the shaft. Then, without rotating the shaft, tighten cap screws to 35 in.-lbs. Measure gap between cover and housing next to cap screws. Subtract the average gap from 0.245 inch to determine the correct spacer. Spacers are available in thicknesses of 0.146 and 0.186 inch in increments of 0.005 inch. Remove cap and master spacer and install correct spacer and cap. Tighten cap screws to a torque of 35 ft.-lbs. Use new gasket and install bottom cover on housing.

Refer to paragraphs 105 and 106 and clean, inspect and overhaul drive control valve and the multi-valve. Reinstall the valves.

NOTE: It is recommended that the range transmission and differential housing (rear frame) be flushed with mineral spirits and compressed air before installing the repaired hydrostatic drive assembly. Also refer to SYSTEM CLEAN-UP in paragraph 108.

Using a new gasket, install hydrostatic drive assembly to rear frame. Install pump drive gear and snap ring on

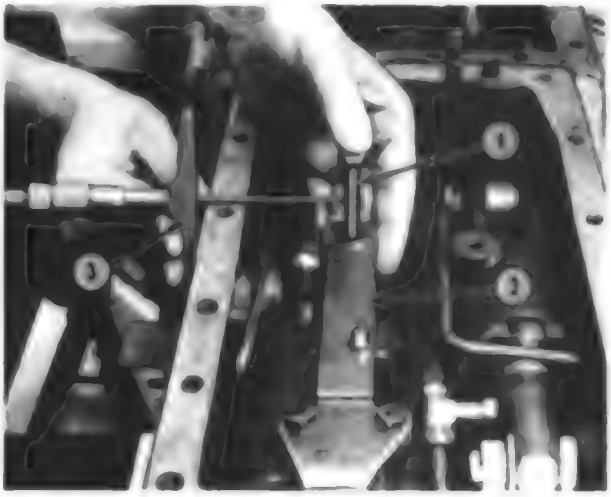


Fig. 129 – Use a depth micrometer set at 3.243 inches to position the pump servo. Refer to text.

1 Pin (assembly)
2 Variable orifice adjusting block
3 Depth micrometer

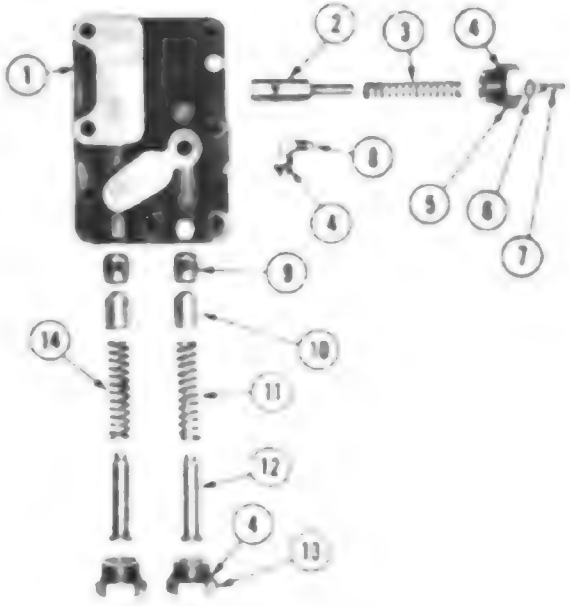


Fig. 130 – Exploded view of the multi valve assembly.

1 Valve body
2 Oil cooler by pass valve
3 By-pass spring
4 "O" ring
5 Plug
6 Oil seal
7 Pressure check pin
8 Elbow
9 Valve bushing
10 Poppet valve
11 Max. relief spring
12 Guide pin
13 Plug
14 Min. relief spring

pto shaft. Reinstall pto clutch and the lower pto drive shaft. If hydrostatic drive plate was removed, bolt drive plate to flywheel. Apply a light coat of "Molycote" or equivalent to hydrostatic drive input shaft splines. Use aligning dowel pins and attach engine to hydrostatic drive housing. The balance of reassembly is the reverse of disassembly procedure. Fill assembly with "Hy-Tran" oil and bleed air from system. Refer to SYSTEM CLEAN UP in paragraph 108 and ADJUSTMENTS starting with paragraph 86.

104. **OVERHAUL EXTERIOR CONTROL VALVES.** If troubleshooting checks indicate a faulty valve or if entire system is being cleaned, disassemble, clean and repair or renew valves as outlined in the following paragraphs.

105. MULTI-VALVE. The multi-valve (Fig. 130) contains the minimum (80 psi) pressure relief valve, maximum (180 to 240 psi) pressure relief valve and the oil cooler by-pass valve. To disassemble the unit, remove plugs (13), then withdraw guide pins (12), maximum relief spring (14), poppet valves (10) and valve bushings (9). Remove plug (5) with pin (7), spring (3) and oil cooler by-pass valve (2). Clean and inspect all parts and renew any showing excessive wear or other damage. All parts are serviced separately. Lubricate with clean "Hy-Tran" fluid and reassemble by reversing disassembly procedure.

106. DRIVE CONTROL VALVE. To disassemble the drive control valve, refer to Fig. 131 and remove plug (1) with "O" ring (2). Withdraw valve pin (6), spring (5) and anti-coast valve (7). Unscrew plug (8) and remove the deceleration and check valve assembly (items 8 through 19). This assembly is referred to as capsule "B" and normally is withdrawn as an assembly. However, if the capsule comes apart during removal, lay parts out in order. Springs (10 and 15) and balls (11 and 16) must not be interchanged.

Unscrew plug (20) and remove the combination check valve assembly (items 20 through 32) which is referred to as capsule "A". If capsule "A" comes apart during removal, lay parts out in order as they are removed. Springs (22 and 28) and balls (23 and 29) must not be interchanged. Remove actuating lift pin (33) from valve body.

Remove end plug (36) with "O" ring (37), then withdraw valve spool (42) with centering spring assembly. Remove snap ring (38), spring (40) and washers (39 and 41). Remove oil seal (34) from valve body.

Clean and inspect all parts for excessive wear or other damage. Spool (42), anti-coast valve (7) and valve pin (6) are selected fits and are not serviced separately. The valve pin is a loose, but matched fit in the anti-coast valve. Spool (42) is a close fit in valve bore but must be free to move without binding. Capsule "A" (items 20 through 32) and capsule "B" (items 8 through 19) are available as assemblies.

Lubricate parts with "Hy-Tran" fluid, use new oil seal, "O" rings and back-up rings and reassemble by reversing the

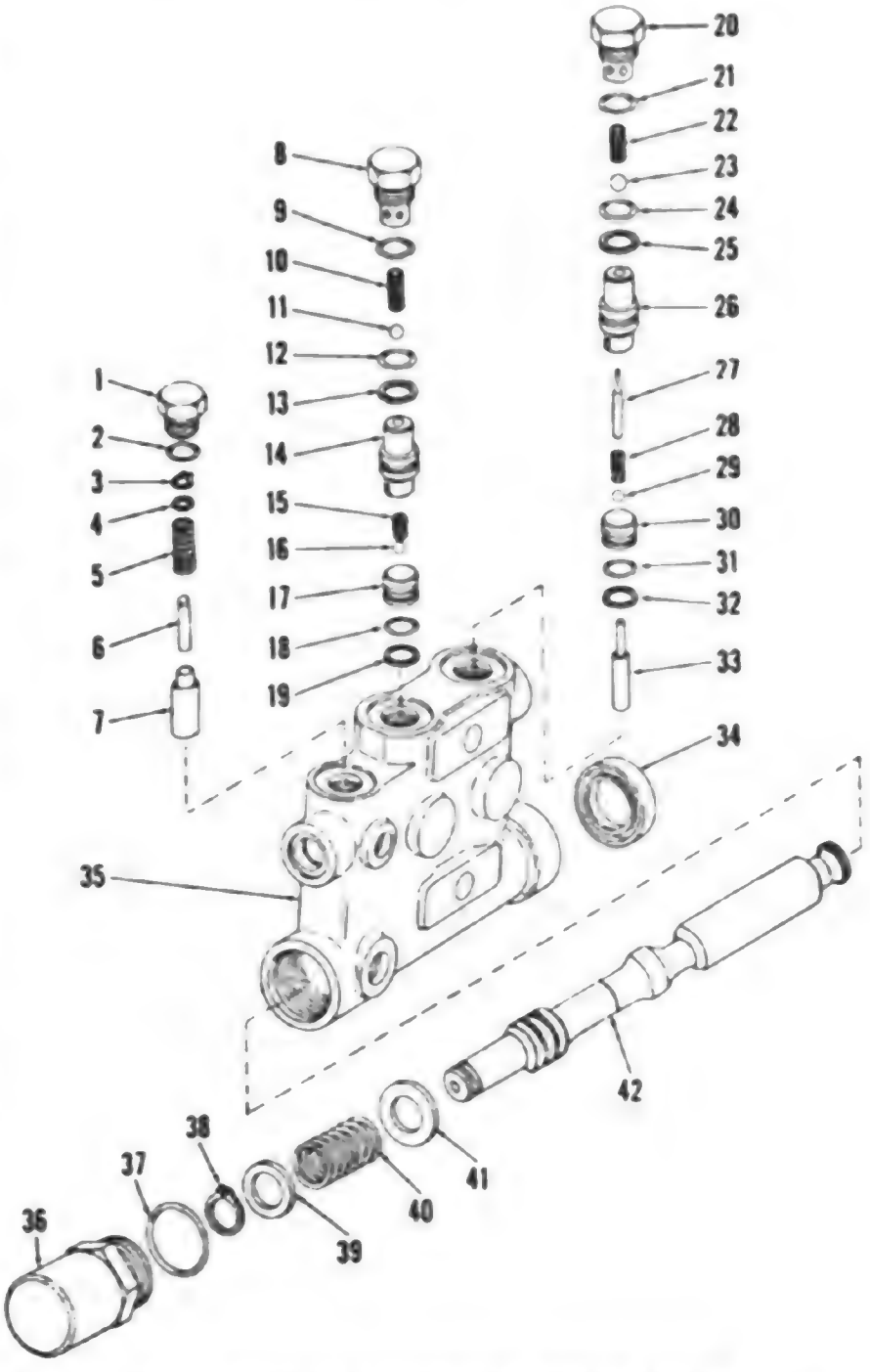


Fig. 131 – Exploded view of hydrostatic drive control valve assembly.

1. Plug
2. "O" ring
3. Snap ring
4. Washer
5. Spring
6. Valve pin
7. Anti-coast valve
8. Plug
9. "O" ring
10. Spring
11. Steel ball
12. "O" ring
13. Back-up ring
14. Deceleration & check valve body
15. Spring
16. Steel ball
17. Seat
18. "O" ring
19. Back-up ring
20. Plug
21. "O" ring
22. Spring
23. Steel ball
24. "O" ring
25. Back-up ring
26. Combination check valve body
27. Follower lift pin
28. Spring
29. Steel ball
30. Seat
31. "O" ring
32. Back-up ring
33. Actuating lift pin
34. Oil seal
35. Valve body
36. Plug
37. "O" ring
38. Snap ring
39. Washer (outer)
40. Centering spring
41. Washer (inner)
42. Valve spool

disassembly procedure.

107. FOOT-N-INCH VALVE. To disassemble the Foot-N-Inch valve, remove guide (9 – Fig. 132) with "O" ring (8) and oil seal (10). Withdraw stem (7), shims (6), spring (5) and poppet (4). Remove valve seat (1) with "O" ring (2).

Clean and inspect all parts. Check the valve seat and poppet for excessive wear or imbedded material. The seat and fitting is a special dimension from the shoulder to the seat and must not be altered. When reassembling, use new "O" rings and oil seal. Install the correct spring and shim pack.

108. SYSTEM CLEAN-UP. To clean up the system after overhauling the hydrostatic drive unit, range transmission or differential, remove, clean and reinstall the oil cooler and lines. Make certain filter by-pass valves are clean and install new filter elements on hydrostatic drive and on multiple control valve. Fill system with "Hy-Tran" fluid. Install a special clean-up filter FES 2-87 (with a FES 1-3 pressure gage in inlet side) in a rear auxiliary valve outlet. Place the discharge hose from the clean-up filter into the transmission fluid filler hole. Start engine and operate at 800 rpm. Actuate auxiliary valve and direct flow through the clean-up filter. Increase engine rpm until pressure gage on filter reads 50 psi or the engine speed reaches 1600 rpm. Drive tractor approximately one hour in high range at this engine speed. Operate tractor in forward and reverse. At least once every 15 minutes during the one hour clean-up, operate all hydraulic circuits to flush the systems.

As the special clean-up filter removes dirt and other foreign material from the hydrostatic fluid, pressure gage reading will increase. Do not allow pressure to raise above 100 psi.

After completion of the clean-up period, stop engine and remove the special clean-up filter. Install new filter elements, then check transmission fluid level. Add fluid as required.

LUBRICATION AND FILTERS

Model Hydro 84

109. The tractor rear frame serves as a common reservoir for the hydrostatic drive and all hydraulic and lubrication operations. The filter elements should be renewed at 10 hours, 100 hours and then every 200 hours of operation thereafter. Hydraulic fluid should be drained and new fluid installed every 800 hours of operation or once a year, whichever occurs first. Only IH "Hy-Tran" fluid should be used and level should be maintained at full mark on dipstick.

To check fluid level, operate engine at 1600 rpm for three minutes and check level with engine operating.

MAIN DRIVE BEVEL GEARS AND DIFFERENTIAL

The differential is carried on tapered roller bearings. The bearing on the bevel gear side of the differential is larger than that on the opposite side and therefore, it is necessary to keep the bearing cages in the proper relationship.

The differential assembly for Model Hydro 84 has two pinions with a single cross shaft (Fig. 133). Models 684, 784 and 884 have four pinions and four stub shafts (Fig. 134). The differential lock is on the right hand side of all models.

ADJUSTMENT

All Models

110. CARRIER BEARING PRELOAD. The carrier bearings can be adjusted by either of two methods. However, in either case the platform, fenders, fuel tank and hydraulic lift assembly should be removed as outlined in paragraph 84 and the final drives removed as outlined in paragraph 117.

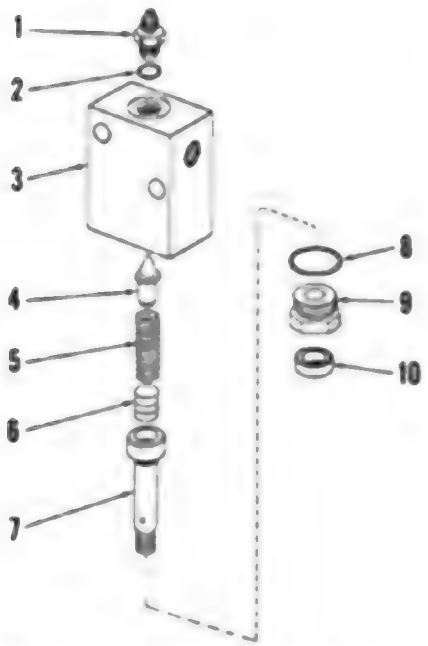


Fig. 132 – Exploded view of the Foot-N-Inch valve assembly.

1. Valve seat
2. "O" ring
3. Valve body
4. Valve poppet
5. Spring
6. Shims
7. Valve stem
8. "O" ring
9. Guide
10. Oil seal

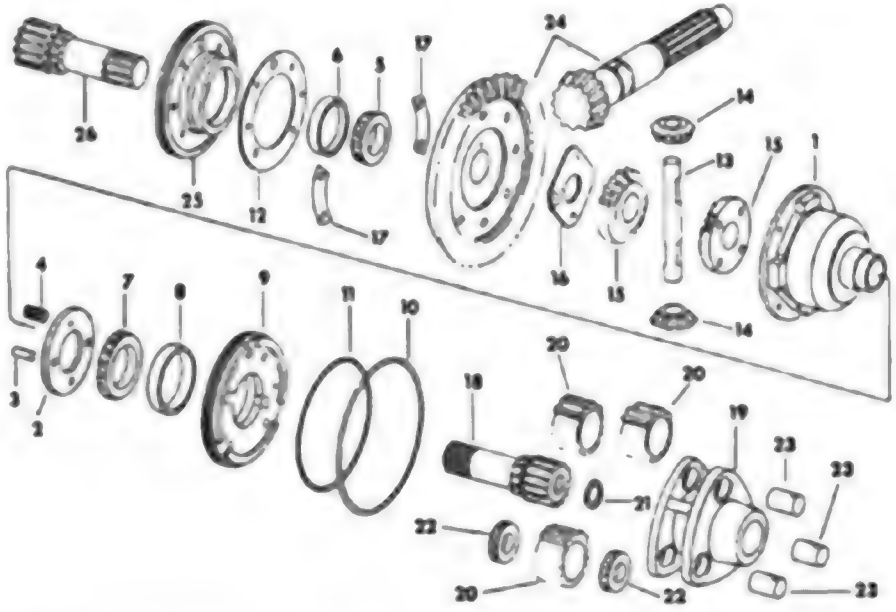


Fig. 133 – Exploded view of differential, planetary unit and associated parts used on Model Hydro 84 tractors.

1. Differential case
2. Differential lock ring
3. Pin
4. Spring
5. Bearing cone (L.H.)
6. Bearing cup (L.H.)
7. Bearing cone (R.H.)
8. Bearing cup (R.H.)
9. Differential bearing cage (R.H.)
10. "O" ring
11. "O" ring
12. Bearing cage shims
13. Differential pinion shaft
14. Pinion gears
15. Bevel gears
16. Thrust washer
17. Lock plates
18. Planetary drive shaft (R.H.)
19. Carrier
20. Planetary gears
21. Shims
22. Bearing cone
23. Pins
24. Ring gear and pinion
25. Differential bearing cage (L.H.)
26. Planetary drive shaft (L.H.)

111. To use the direct measurement method, proceed as follows: Install differential in rear frame with no "O" rings or shims behind bearing cages and tighten right bearing cage cap screws to a torque of 85 ft.-lbs. Rotate the differential and tighten the left hand bearing cage cap screws in steps of 25, 50, 75 and 100 in.-lbs. torque. Loosen the left hand bearing cage cap screws, rotate differential and retighten cap screws to 20 in.-lbs. Then, without rotating differential, tighten bearing cage cap screws to 30 in.-lbs. torque. Insert a depth gage through puller bolt holes and measure between the surface of rear main frame and machined surface (Fig. 135) of bearing cage and average the readings. Remove the left hand bearing cage and measure the thickness as shown in Fig. 136. Subtract second reading from first reading which will give the required thickness of shim pack.

If bearing cage has feeler gage slots (Fig. 137), measure with feeler gage for the right thickness of shim pack. Shim pack on either type of bearing cage must be within 0.002 inch of the determined shim pack thickness. Shims are available in thicknesses of 0.003, 0.007, 0.012 and 0.0299 inch. Shims can be divided between the two bearing cages to provide the proper backlash as outlined in paragraph 113.

112. To use the rolling torque method, use the original shim packs behind bearing cages and rotate the differential as bearing cage cap screws are tightened. Be sure there is some backlash maintained between bevel gear and pinion. Place the range transmission in neutral, then loosen the left bearing cage so there is no preload on bearing (cap screws finger tight). Wrap a cord around differential, attach to a spring scale and note the pounds pull required to keep differential and drive pinion in motion. Tighten bearing cage cap screws evenly to a torque of 85 ft.-lbs. and recheck the rolling torque. Then, vary the shims until one to three pounds more pull is required to keep differential and transmission in motion than when no preload was applied to bearings. With bearing preload determined, refer to paragraph 113 to set backlash between bevel gear and pinion.

113. **BACKLASH ADJUSTMENT.** With the differential carrier bearing preload determined as outlined in paragraph 111 or 112, the backlash between bevel gear and drive pinion should be checked and adjusted as follows: Mount a dial indicator and while holding drive pinion forward, check backlash in at least three places during a revolution of the differential. Correct backlash is 0.006-0.011 inch. If the backlash is not as stated, shift bearing cage shims from one side to the other as required. Do not add or remove shims as the previously determined bearing preload will be changed. Shifting 0.010 inch shim thickness from one side to the other will change backlash approximately 0.0075 inch.

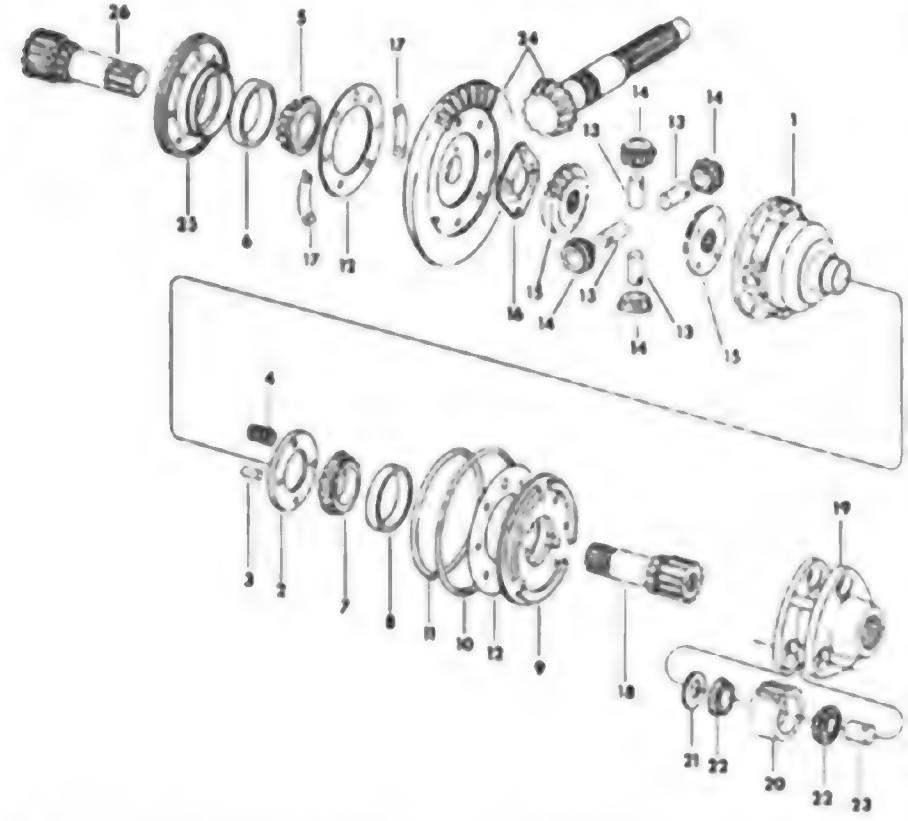


Fig. 134 – Exploded view of differential, planetary unit and associated parts used on Models 684, 784 and 884

1. Differential case
2. Differential lock ring
3. Pin
4. Spring
5. Bearing cone (L.H.)
6. Bearing cup (L.H.)
7. Bearing cone (R.H.)
8. Bearing cup (R.H.)
9. Differential bearing cage (R.H.)
10. "O" ring
11. "O" ring
12. Bearing cage shims
13. Differential pinion shafts
14. Pinion gears
15. Bevel gears
16. Thrust washer
17. Lock plates
18. Planetary drive shaft (R.H.)
19. Carrier
20. Planetary gears
21. Shim
22. Bearing cone
23. Pin
24. Ring gear and pinion
25. Differential bearing cage (L.H.)
26. Planetary drive shaft (L.H.)

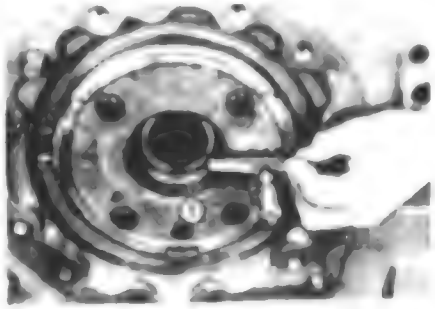


Fig. 135 – Using a depth micrometer to determine shim pack required on early production tractors. Refer to text.

Fig. 136 – Measuring the thickness of left hand carrier. Refer to text.

Fig. 137 – On late production tractors with feeler gage slots, use feeler gage to determine shim pack required. Refer to text.

R&R BEVEL GEARS

All Models

114. The main drive bevel pinion is also the range transmission mainshaft. The procedure for removing, reinstalling and adjusting pinion setting is outlined in the RANGE TRANSMISSION section paragraph 84.

To remove the bevel ring gear, follow the procedure outlined in paragraph 115 for R&R of differential. The ring gear is secured by the differential case type 8 cap screws which should be tightened to a torque of 115-130 ft.-lbs. Use "Loctite" #262 on the cap screw threads.

R&R DIFFERENTIAL

All Models

115. Model Hydro 84 is equipped with a two pinion differential (Fig. 138) and Models 684, 784 and 884 are equipped with a four pinion differential (Fig. 139).

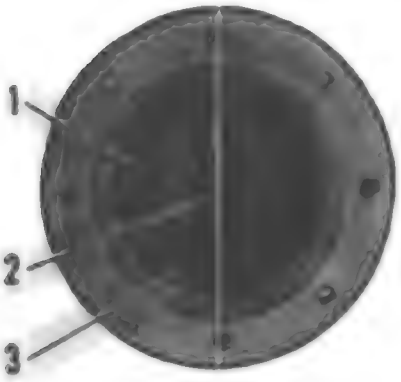


Fig. 138 – View of the differential bevel gear and pinion gears used in Model Hydro 84 tractors.
1. Bevel gear
2. Pinion shaft
3. Pinion gear (2 used)

Fig. 139 – View of the differential bevel gear and pinion gears used in Models 684, 784 and 884.
1. Pinion shaft (4 used)
2. Pinion gear (4 used)
3. Bevel gear

To remove the differential, remove final drives as outlined in paragraph 117 and the hydraulic lift assembly as outlined in paragraph 136.

With final drives and hydraulic lift assembly removed, attach a hoist to the differential assembly. Remove both differential bearing cages and carefully lift differential from rear frame.

To disassemble differential, use a puller and remove the carrier bearings and note that bearing on bevel gear side of differential is a larger bearing. The differential lock will be removed with the carrier bearing on the right side. Remove the cap screws securing the ring gear to differential. Any further disassembly is obvious.

When reassembling differential, line holes in pinion shaft or shafts with holes in differential case. Using type 8 cap screws, secure ring gear to differential carrier. The dowel type cap screws also secure the differential pinion shaft or shafts. Cap screw threads should be dry and free of oil. Apply "Loctite" #262 on screw threads and tighten the cap screws to a torque of 115-130 ft.-lbs. Refer to paragraphs 110 through 113 for carrier bearing preload and backlash adjustment.

DIFFERENTIAL LOCK

All Models

Tractors are equipped with a differential lock which operates on the right hand side of the differential with a dowel pin type coupling locking the differential gears. It is operated with a pedal at the rear of foot plate on right side of tractor.

Refer to Fig. 140 for an exploded view of differential lock linkage and to Items 2, 3, 4 and 15 – Fig. 133 or 134 for differential lock.

116. **R&R AND OVERHAUL.** Removal and overhaul of the differential lock requires removal and separation of the differential assembly as outlined in paragraph 115.

Overhaul of the differential lock is obvious after an examination of the unit.

When reassembling, loosen adjusting nut (9 – Fig. 141) until it is flush with end of eye bolt (7). Loosen locknut (8) and disconnect rod (2) from actuating shaft lever (1). Move lever (1) forward until fork (14 – Fig. 140) and cam (15) are bottomed in fully engaged position. With pedal (4 – Fig. 141) touching the foot plate, adjust rod (2) to align with hole in lever (1). Secure rod and tighten locknut (3). Adjust nut (9) until pedal will return to up (disengaged) position, then tighten the nut two additional turns. Secure eye

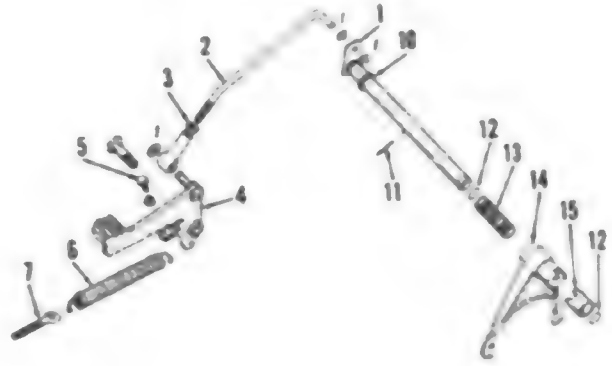


Fig. 140 – Exploded view of differential lock linkage.
1. Shaft and lever
2. Rod
3. Locknut
4. Pedal
5. Pedal adjusting bolt
6. Spring
7. Eye bolt
10. Shim washers
11. Roll pin
12. "O" ring
13. Adjusting spring
14. Fork
15. Cam

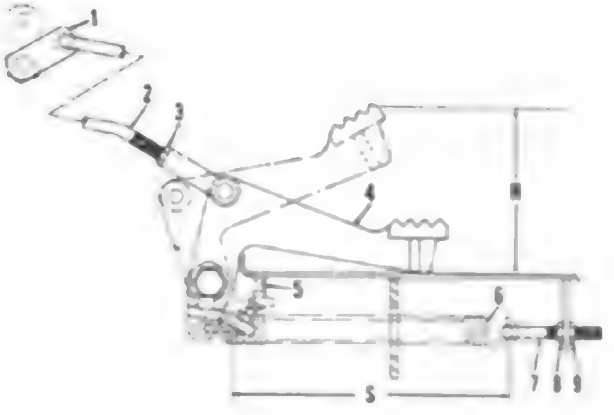


Fig. 141 – Differential lock linkage adjustment. Refer to text.
1. Adjusting shaft lever
2. Rod
3. Locknut
4. Pedal
5. Adjusting bolt
6. Spring
7. Eye bolt
8. Locknut
9. Adjusting nut

bolt in position with locknut (8). Adjust stop bolt (5) until distance from top of pedal in disengaged position to foot plate (dimension H) is 5.4 inches.

When pedal is in disengaged (up) position, length of spring (dimension S) should be approximately 9 inches.

FINAL DRIVE

The final drive assemblies consist of the rear axle, planetary unit and outer brake disc ring and can be removed from the tractor as a unit.

All Models

117. **REMOVE AND REINSTALL.** To remove either final drive, remove drain plug and drain housing. Remove the seat and left and right vertical covers. Disconnect wiring harness on right and left sides, fuel lines and the park brake assembly from the left fender. Disconnect variable valve flow control line and remove control lever knobs. Remove platform and fender mounting bolts from axle housings and lift housing. Remove fuel tank, platform and fenders as an assembly. When removing final drive on left side, remove the hydraulic supply line to the hitch and auxiliary valves from the multiple control valve. Disconnect 3-point hitch lower link from axle housing. Support rear frame with a floor jack and remove rear wheel. Attach a hoist to axle housing, then unbolt and remove the final drive assembly as shown in Fig. 142.

Reinstall by reversing the removal procedure. Use new gaskets and tighten axle housing retaining cap screws to a torque of 170 ft.-lbs

118. **OVERHAUL PLANET CARRIER.** With final drive assembly removed as outlined in paragraph 117, proceed as follows: Remove outer brake disc (20 – Fig. 143) and cap screw securing the planetary unit to axle shaft.

NOTE: When removing the planetary unit, check for shims (10) between retainer (14) and axle (1). Keep the shims together.

With planet carrier removed from final drive assembly, drive roll pins into the planet pins (12) from outside of carrier (13). Then, drive or press planet pins out of carrier and remove each planet gear, bearings and retainer (14). Remove roll pins from planet pins for reassembly.

Inspect gears and bearings for damage or wear and renew as necessary.

When reassembling, it will be necessary to determine shims needed for preload of planet gear bearing as follows: Using two flat washers (2 inch O.D. x 17/32-inch I.D. x 1/8-inch thick), cut on dotted line as shown in Fig. 144. Then, using a ½-inch NF x 3 inch cap screw and nut, secure the cap screw in a vise with threaded end pointing upward. Lubricate the bearings with "Hy-Tran" oil and position over the cap screw with bearing and washer on each side of gear.

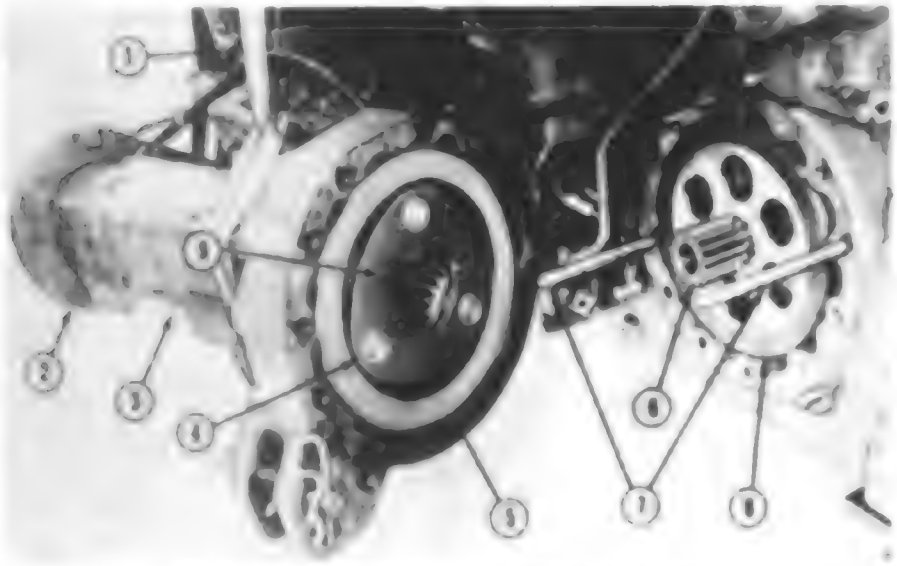


Fig. 142 – View showing final drive assembly being removed.

1. Sling
2. Rear axle
3. Axle carrier
4. Planetary carrier
5. Brake outer disc
6. Drive shaft
7. Aligning dowels
8. Brake center disc
9. Cap screw

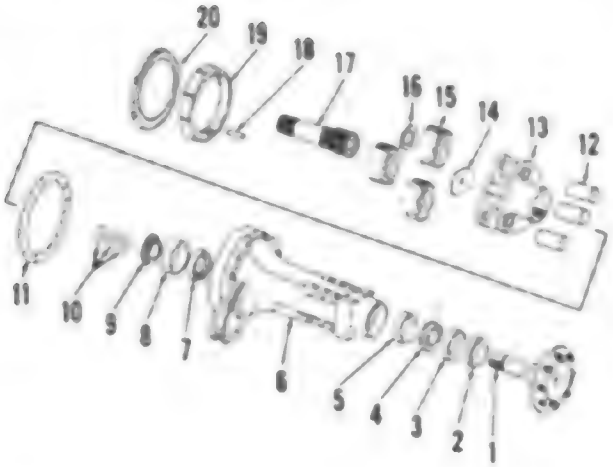


Fig. 143 – Exploded view of planetary and rear axle components.

1. Axle
2. Wear sleeve
3. Seal
4. Bearing cone
5. Bearing cup
6. Housing
7. Seal
8. Bearing cup
9. Bearing cone
10. Shims
11. Gasket
12. Pin
13. Carrier
14. Retainer
15. Planet gear
16. Shim
17. Planetary shaft
18. Dowel pin
19. Ring gear
20. Brake disc

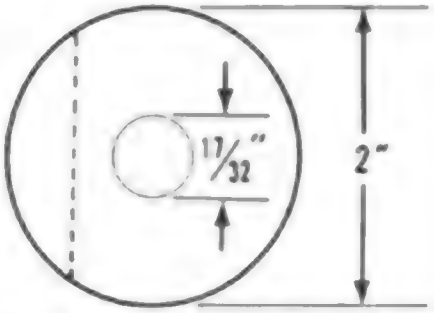


Fig. 144 – Dimension for making washer to determine the shims needed for planet gear preload. Refer to text.

Fig. 145 – Using a micrometer to take a reading on outer faces of bearing cone where washers are cut away. Refer to text.

Tractors	Figure Obtained (inches)	Shims Required (inch)
Hydro 84	1.706-1.712 1.699-1.705 1.692-1.698	0.042 0.049 0.056
684, 784 & 884	2.123-2.127 2.118-2.122 2.113-2.117	0.042 0.049 0.056

Fig. 146 – Chart to determine the shims needed for planet gear bearings. Refer to text.

with washer cuts in alignment. Using an inch-pound torque wrench, tighten nut to 10 in.-lbs. while rotating the gear. Using a micrometer and referring to Fig. 145, take a reading on outer face of bearing cones where washers are cut away. With this reading, refer to chart Fig. 146 for the required shims to obtain bearing preload. Keep each shim pack and gear together after correct shims have been selected.

When reassembling, install one planet gear and its shim pack into carrier and secure in place with planet gear pin and roll pin. Then, place retainer (1 – Fig. 147) in carrier and install the other two planet gears and their selected shim packs.

119. **OVERHAUL REAR AXLE AND RING GEAR.** If it is necessary to remove the ring gear (19 – Fig. 143), remove planet carrier as outlined in paragraph 118. Using a pusher arrangement, push on inner end of axle to remove axle and bearings. Then, with suitable puller remove ring gear from dowels.

Inspect bearings and seals for damage or wear and renew as necessary.

To reassemble, install axle bearing cups and inner oil seal in housing. Install outer oil seal and outer bearing cone on axle shaft.

NOTE: On Row Crop models, outer oil seal can be installed after axle is installed in housing. See Fig. 148.

Pack inner and outer bearing cones with a multi-purpose grease. Install the axle into the housing, drive the inner bearing cone on axle until the planetary carrier assembly can be installed. Tighten the cap screw to draw the bearing cone in until there is 0.001-0.010 inch axle end play. Check with dial indicator. Using an inch-pound torque wrench on the planet carrier cap screw, turn at a slow rotation and record the reading. Tighten bolt and continue to draw bearing in and recheck rolling torque until a reading of 20 to 30 in.-lbs OVER the first reading is obtained. Then, remove cap screw and planet carrier from axle housing.

With carrier removed, measure the distance between end of axle and inner bearing face as shown in Fig. 149 and record the reading. Refer to Fig. 150 and measure the distance from face of hub to retainer, using the planetary drive shaft (3) to hold retainer (2) in place. Select shims within 0.002 inch of the difference between first and last reading. This will be the correct shim pack to be installed. Shims of 0.007, 0.012 and 0.0299 inch thicknesses are available in a rear axle shim package.

Install ring gear with dowels, if removed, by using a wooden block and tapping ring gear equally all the way around. Then, coat selected shim pack with petroleum jelly and install on end of axle. Install planet carrier on axle being careful not to drop the shims. Install cap screw and torque to 250 ft.-lbs. Install outer brake disc.

BRAKES

Brakes on all models are self equalizing hydraulic actuated wet type single disc brakes. Brakes are located on the differential output shafts (planetary drive shafts) and are accessible after removing final drive units as outlined in paragraph 117. Return hydraulic fluid from the oil cooler maintains a full master cylinder directly from a tee in the return line on early models (Fig. 151). On later models, a reservoir was added to the keep fill system (Fig. 152). Brake operation can be accomplished with engine inoperative because of the keep fill line or reservoir which keeps the master cylinders filled. Also in the brake system is an equalizer valve (3 – Fig. 153). This valve permits equal

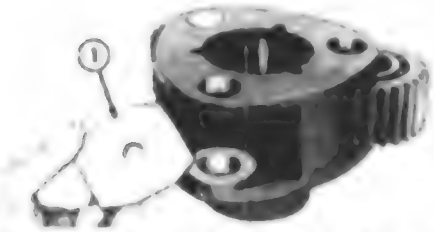


Fig. 147 – Install retainer before the last two planet gears are installed.

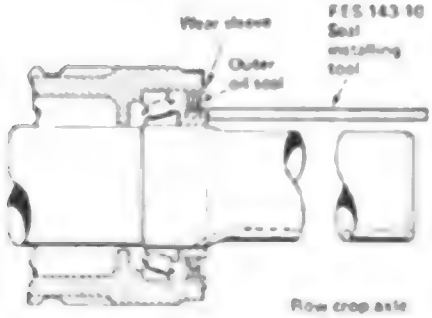


Fig. 148 – On Row Crop models, outer oil seal can be installed after axle shaft is installed in housing, using seal installing tool FES 143-10.

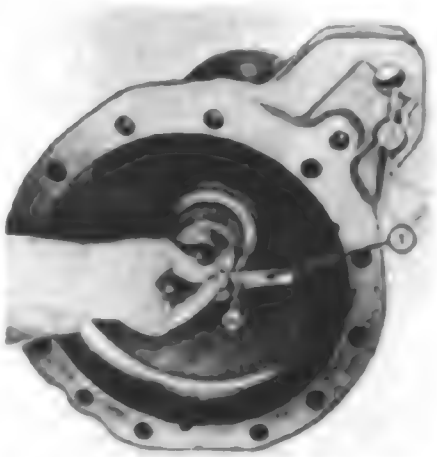


Fig. 149 – Using a depth micrometer to measure distance from end of axle to inner bearing cone. Refer to text.

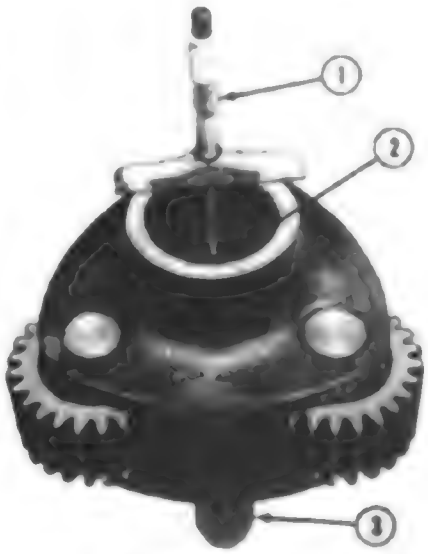


Fig. 150 – With planetary drive shaft supporting the retainer, use a depth micrometer to obtain hub to retainer dimension as shown. Refer to text.

1. Depth micrometer
2. Retainer
3. Planetary drive shaft

flow to both brake pistons when both brake pedals are depressed. If one brake is applied, the equalizer does not function.

Service (foot) brakes MUST NOT be used for parking or any other stationary job which requires the tractor to be held in position. Even a small amount of fluid seepage would result in brakes loosening and severe damage to equipment or injury to personnel could result. USE PARK BRAKE when parking tractor. Refer to paragraph 84 for park brake adjustment.

BRAKE ADJUSTMENT

All Models

120. The only external adjustment that can be made on brakes is the brake pedal maximum travel.

To adjust the brake pedal maximum travel, refer to Fig. 153 and proceed as follows: Loosen locknuts (6) and rotate the eccentric bolts (5) to obtain the correct pedal free height from top of brake pedal to the foot plate. Then, retighten the locknuts. Correct pedal free height for Model 684 with S/N B001150 and later, Model 784 with S/N B001280 and later, Model Hydro 84 with S/N B000720 and later and all Model 884 tractors is 8¼ inches. Pedal free height for all models with prior serial numbers should be set at 6 inches.

BLEED BRAKES

All Models

121. To bleed the brakes, start the tractor and let it run for a few minutes to insure the brake lines are filled. Keep engine operating while bleeding brakes. Clamp brake return hose to the transmission to prevent the return oil flow. Attach two plastic hoses ¼-inch I.D. x 30 inches long over brake bleeder fittings. Run opposite end of hoses into the hydraulic filler hole. Bleeder fittings are located in hydraulic housing above final drives.

Depress brake pedal and while holding in this position open bleeder valve. When a solid flow of fluid appears, close the valve. Repeat operation on opposite brake. Check brake pedal feel. If brake pedal operation feels spongy rather than having a solid feel, repeat the bleeding operation.

BRAKE ASSEMBLIES

All Models

122. **R&R AND OVERHAUL.** Removal of either brake is accomplished by removing final drive as outlined in paragraph 117. Refer to Fig. 142 showing final drive removed from tractor. Remove the planetary drive shaft. Remove brake disc (1 - Fig. 154), inner brake ring (2) and brake piston (3) with "O" ring (4). Refer to Fig. 155 for removal procedure of brake piston.

With brake disassembled, clean and inspect all parts. Renew any parts showing excessive wear or other damage.

When reassembling, install new "O" ring (4 - Fig. 154) on piston and lubricate "O" ring with petroleum jelly. Install piston in rear frame being careful not to damage the "O" ring.

Reinstall by reversing the removal procedure. When assembly is completed, check pedal free height adjustment as outlined in paragraph 120, then start engine and bleed brakes as in paragraph 121.

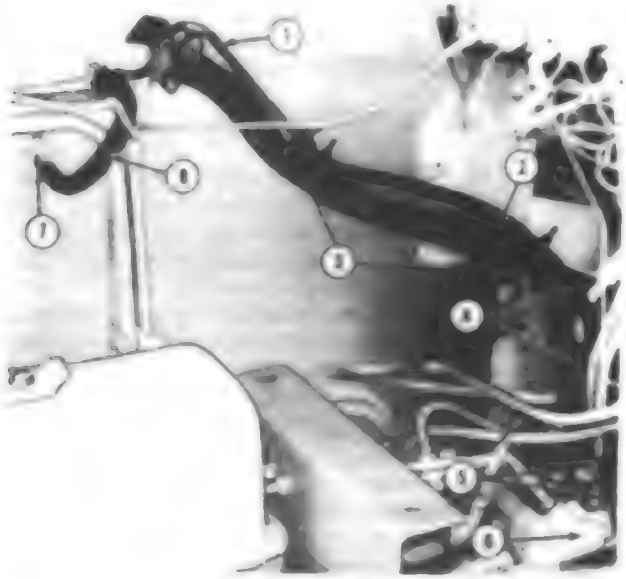


Fig. 151 – Hydraulic brake loop fill system used on early production models.

1. Tube
2. Cap
3. Bracket
4. Elbow
5. Tube assemblies with screens
6. Master cylinder
7. Brake orifice & screen assy
8. Hose

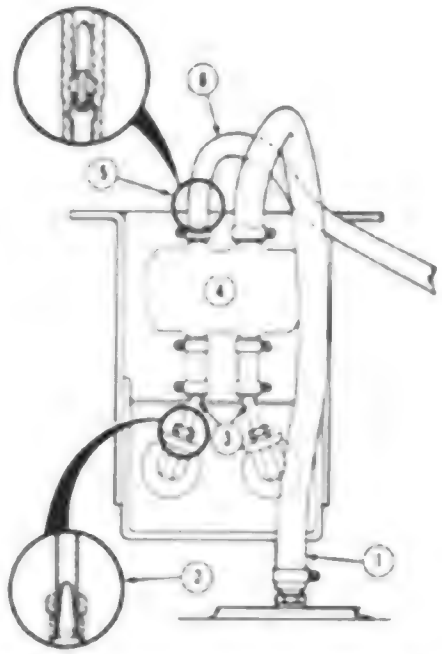


Fig. 152 – Reservoir (4) was added to brake loop fill system on later production models.

1. Oil return line
2. Screen in each tube (3)
3. Tubes to master cylinder
4. Reservoir
5. Brake orifice & screen
6. Supply line from oil cooler

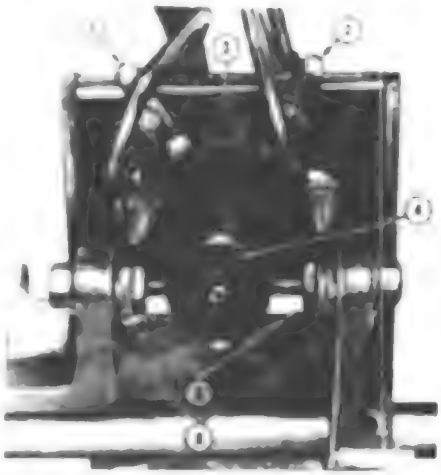


Fig. 153 – View of brake pedal adjusting bolts and equalizer. Refer to text.

1. Brake line (L.H.)
2. Brake line (R.H.)
3. Equalizer
4. Equalizer plate
5. Eccentric bolts
6. Locknuts

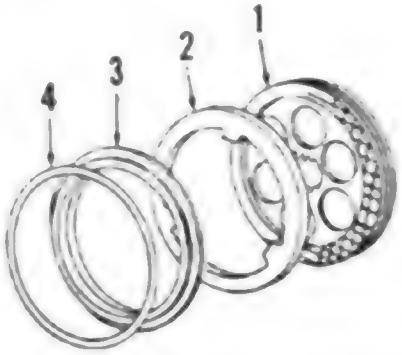


Fig. 154 – Exploded view of brake piston and disc.

1. Brake disc
2. Ring
3. Piston
4. "O" ring

BRAKE MASTER CYLINDERS AND EQUALIZER VALVE

All Models

123. REMOVE AND REINSTALL. Remove brake master cylinders and equalizer valve as follows: Remove hood and rear side panels. Remove battery and lower plate of battery box. Disconnect all necessary lines from the master cylinders. Remove the snap ring securing the equalizer plate to equalizer and remove pedal adjusting eccentric bolts. Unbolt and remove master cylinders separately or unbolt bracket and remove as an assembly.

Between the oil cooler return line and the keep fill line (early models) or reservoir (later models), there is an orifice screen located in the hose. Refer to Figs. 151 and 152. When installing this orifice screen, install screen towards oil cooler. This orifice provides the proper amount of fluid to the master cylinders. There is also a filter screen located in the lines going into each master cylinder.

Reinstall by reversing the removal procedure. Adjust pedal travel as outlined in paragraph 120 and bleed the brakes as in paragraph 121.

124. OVERHAUL MASTER CYLINDER. With master cylinder removed, refer to Fig. 156 and remove boot (5) and snap ring (3). Remove plunger (7), seal (8) and all other internal parts (9 through 14) as a unit.

Clean and inspect all parts. Pay particular attention to cylinder bore for scoring or ridges. Use all new seals and reassemble by reversing disassembly procedure.

When installing valve seal (14), the smallest diameter is to be installed first on the head of valve stem (13). Also refer to Fig. 157 for installing valve seal.

125. OVERHAUL EQUALIZER VALVE. With equalizer valve removed, refer to Fig. 158 and remove snap ring (12) and equalizing plate (11). Tap the spool (3) from snap ring end to knock plug (1) out the opposite end, then remove spool and spring. Remove the fittings (10), springs (8), 5/16-inch balls (7) and 3/16-inch balls (6).

Clean and inspect all parts. Renew all "O" rings and any other parts that are worn or damaged.

Reassemble by reversing the disassembly procedure.

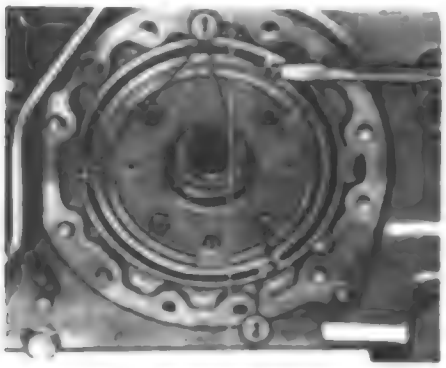


Fig. 155 – Install screws (1) and pry brake piston (2) from housing.

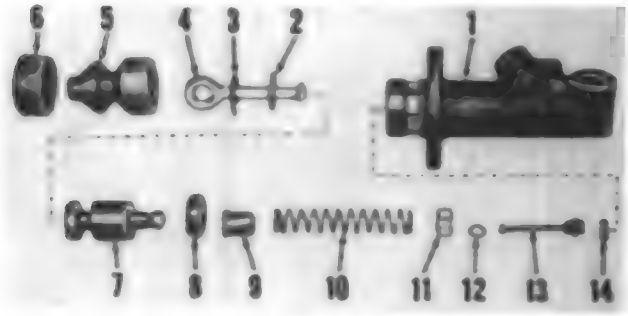


Fig. 156 – Exploded view of brake master cylinder.

1. Body
2. Retainer
3. Snap ring
4. Push rod
5. Boot
6. Sleeve
7. Plunger
8. Seal
9. Retainer
10. Spring
11. Spacer
12. Spring washer
13. Valve stem
14. Seal

POWER TAKE-OFF

The power take-off used on all models is an independent type. The pto is available as a dual speed unit having both 540 and 1000 rpm rear output shafts on Models 784 and 884 or as a single speed (540 rpm) on Models 684 and Hydro 84. An optional 1000 rpm side mount pto unit is available for all models. Oil for the pto unit on all models is furnished from the hydraulic pump through the multiple control valve. From the MCV, the oil is supplied through a cored passage in the rear frame to the 1000 rpm output shaft (Models 784 and 884) or lower pto drive shaft (Models 684 and Hydro 84) to actuate the pto clutch. Operation of the pto clutch unit is controlled by a spool type valve located in the MCV housing.

PTO LINKAGE ADJUSTMENT

All Models

126. Loosen the pto control handle bolts (Fig. 159). Then, adjust linkage (A) so that pto valve movement is 1-3/16 inches plus or minus 1/32-inch from disengaged to engaged or over-center position. Move the control handle to disengaged position and adjust the lever to center of notch. Tighten bolts in control handle. Then, with engine running, move control lever to the "feathering" notch position. When control lever is released, it should return freely to the disengaged position notch.

OPERATING PRESSURE

All Models

127. To check operating pressure, operate tractor until hydraulic fluid is warmed to approximately 100 degrees

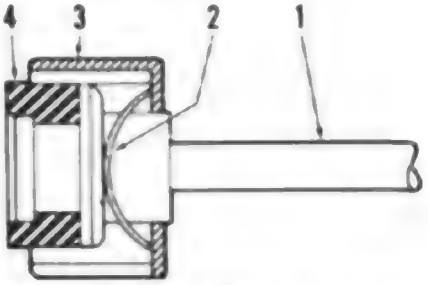


Fig. 157 – Cross sectional view showing the seal installed on valve stem.

1. Valve stem
2. Spring washer
3. Spacer
4. Valve seal

Fig. 158 – Exploded view of equalizer valve.

1. Plug
2. "O" rings
3. Spool
4. Spring
5. Body
6. Check balls (3/16-inch)
7. Check balls (5/16-inch)
8. Check springs
9. "O" rings
10. Tee connectors
11. Equalizer plate
12. Snap ring

F. Refer to Fig. 160 and remove pressure line (1) from tee on left side of tractor. Attach a test gage capable of registering at least 300 psi. Engage pto and operate engine at 2200 rpm. If pressure reading is below 220 psi, remove plug (4) on multiple control valve and install shims as required under the valve plug. When the pressure is set at 220-250 psi, remove the gage and connect pressure line back to the tee. Then, remove the cap from the tee and connect pressure gage as shown in Fig. 161. Operate engine at 2200 rpm and with the pto engaged, there should be a gage reading of 220-250 psi if the sealing rings in the pto clutch piston and the sealing rings and bushings on the 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed), are sealing properly. If pressure is not as stated, remove and overhaul pto unit as outlined in paragraph 128.

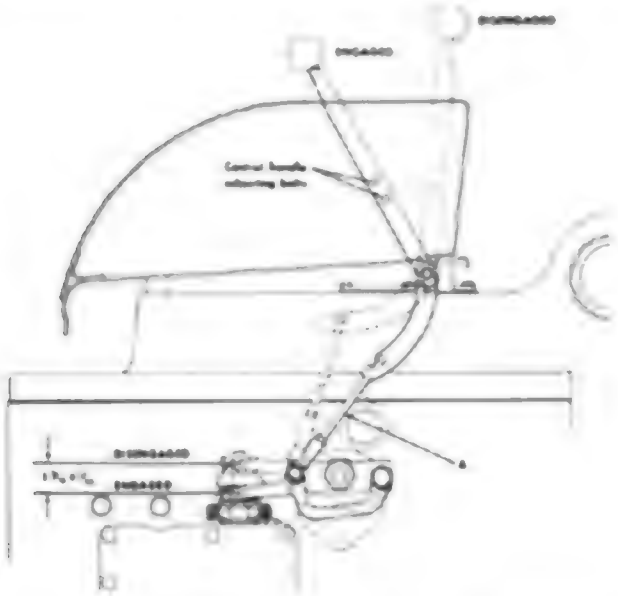


Fig. 159 – View showing linkage adjustment of pto lever. Refer to text.

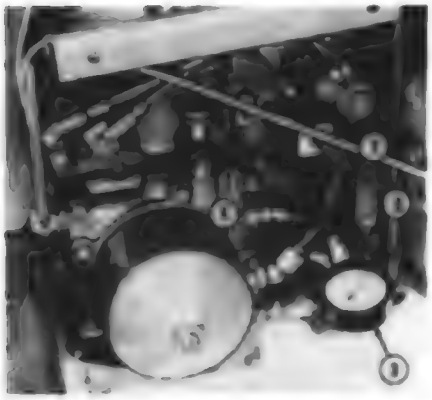


Fig. 160 – View showing gage connection for testing pto pressure. Refer to text.

1. Pressure line
2. Connector
3. Gage (0-300 psi)
4. Pto regulating valve

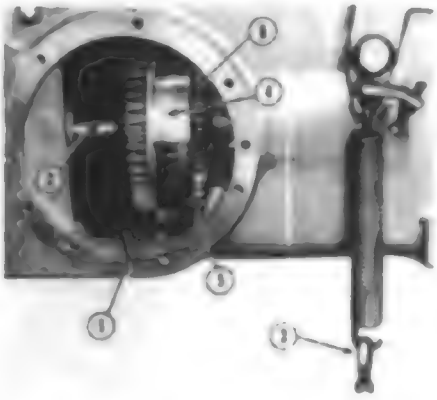


Fig. 162 – Roll pin to be removed from pto clutch to pull the 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed).

1. Roll pin
2. Shaft
3. Spring and eye
4. Clutch assembly
5. Idler gear
6. Drive gear

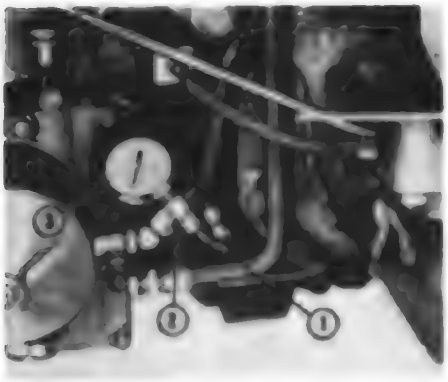


Fig. 161 – Testing for leaks in pto clutch or sealing rings. Refer to text.

1. Pressure line
2. Connector
3. Gage (0-300 psi)

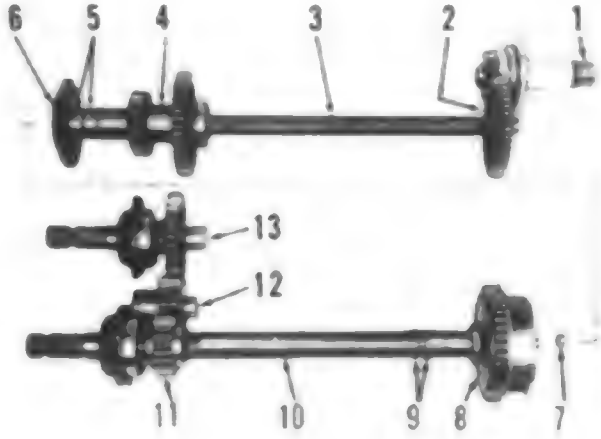


Fig. 163 – Exploded view of typical pto drive train.

1. Drive shaft
2. Driven gear
3. Driven shaft
4. Countershaft drive
5. Countershaft bearing
6. Pump drive gear
7. Pilot bearing
8. Pto clutch assy
9. Sealing rings (2)
10. Output shaft (1000 rpm)
11. Drive gear
12. Idler gear
13. Gear & shaft (540 rpm)

R&R AND OVERHAUL

All Models Equipped With Rear Mount

128. To remove pto clutch, drain the rear main frame, then remove the side pto cover. Refer to Fig. 162 and drive roll pin (1) from the clutch and 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed). Remove the lower bearing flange on rear of main frame. Refer to Fig. 163 and remove shaft (10). If tractor is not equipped with a 1000 rpm shaft that protrudes, there will be a lower pto drive shaft located in the same position as the 1000 rpm shaft. Lower drive shaft will not protrude and will have a bearing cap. After the 1000 rpm shaft or lower drive shaft is pulled rearward, the pto clutch can be removed. Refer to Fig. 164 and using a

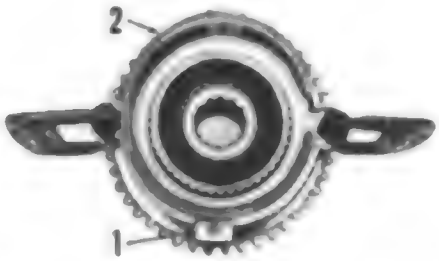


Fig. 164 – View showing "C" clamps used to compress the backing plate and springs for removal of snap ring.

1. Backing plate
2. Snap ring

F. Refer to Fig. 160 and remove pressure line (1) from tee on left side of tractor. Attach a test gage capable of registering at least 300 psi. Engage pto and operate engine at 2200 rpm. If pressure reading is below 220 psi, remove plug (4) on multiple control valve and install shims as required under the valve plug. When the pressure is set at 220-250 psi, remove the gage and connect pressure line back to the tee. Then, remove the cap from the tee and connect pressure gage as shown in Fig. 161. Operate engine at 2200 rpm and with the pto engaged, there should be a gage reading of 220-250 psi if the sealing rings in the pto clutch piston and the sealing rings and bushings on the 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed), are sealing properly. If pressure is not as stated, remove and overhaul pto unit as outlined in paragraph 128.

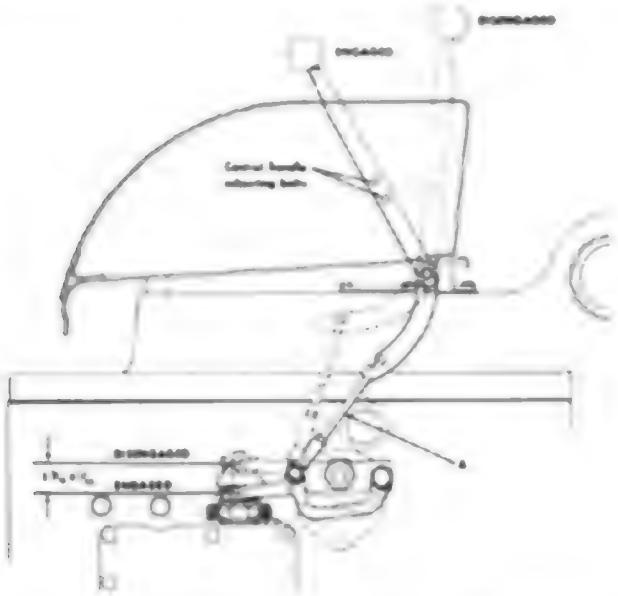


Fig. 159 – View showing linkage adjustment of pto lever. Refer to text.

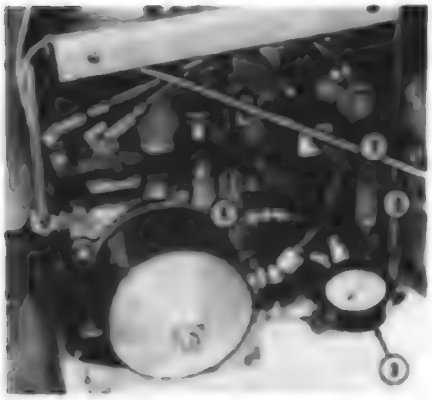


Fig. 160 – View showing gage connection for testing pto pressure. Refer to text.

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2. Connector
3. Gage (0-300 psi)
4. Pto regulating valve

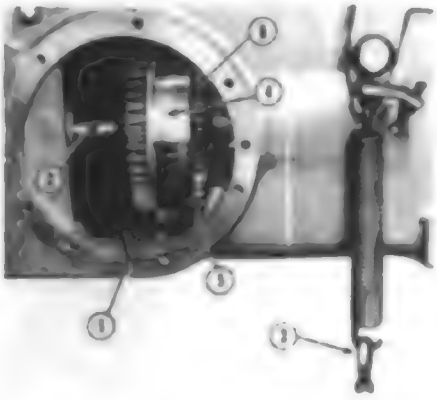

Fig. 162 – Roll pin to be removed from pto clutch to pull the 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed).

1. Roll pin
2. Shaft
3. Spring and eye
4. Clutch assembly
5. Idler gear
6. Drive gear

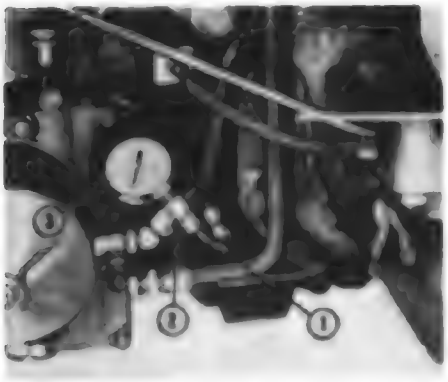

Fig. 161 – Testing for leaks in pto clutch or sealing rings. Refer to text.

1. Pressure line
2. Connector
3. Gage (0-300 psi)

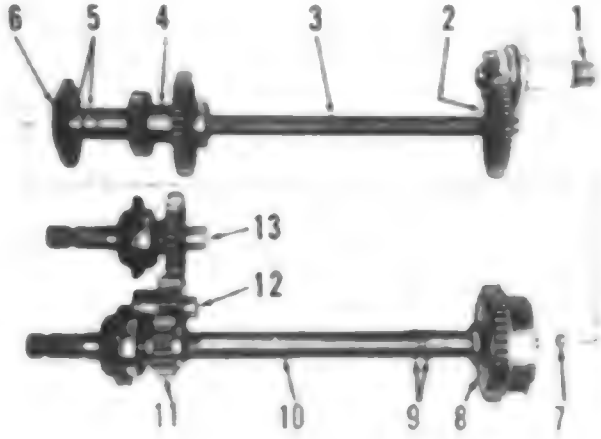

Fig. 163 – Exploded view of typical pto drive train.

1. Drive shaft
2. Driven gear
3. Driven shaft
4. Countershaft drive
5. Countershaft bearing
6. Pump drive gear
7. Pilot bearing
8. Pto clutch assy
9. Sealing rings (2)
10. Output shaft (1000 rpm)
11. Drive gear
12. Idler gear
13. Gear & shaft (540 rpm)

R&R AND OVERHAUL

All Models Equipped With Rear Mount

128. To remove pto clutch, drain the rear main frame, then remove the side pto cover. Refer to Fig. 162 and drive roll pin (1) from the clutch and 1000 rpm output shaft (dual speed) or lower pto drive shaft (single speed). Remove the lower bearing flange on rear of main frame. Refer to Fig. 163 and remove shaft (10). If tractor is not equipped with a 1000 rpm shaft that protrudes, there will be a lower pto drive shaft located in the same position as the 1000 rpm shaft. Lower drive shaft will not protrude and will have a bearing cap. After the 1000 rpm shaft or lower drive shaft is pulled rearward, the pto clutch can be removed. Refer to Fig. 164 and using a

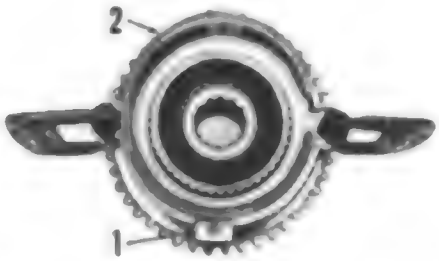

Fig. 164 – View showing "C" clamps used to compress the backing plate and springs for removal of snap ring.

1. Backing plate
2. Snap ring

Fig. 165 – Exploded view of typical pto clutch and component parts.

pair of "C" clamps, compress the piston return springs and remove snap ring (2). Then, remove clutch, backing plate (8 – Fig. 165), return springs (7), driven discs (6) and drive plates (5). There are two driven plates between each clutch disc. Clutch is equipped with eight driven plates, five clutch discs and six return springs.

Remove piston return plate (4) and brake ring (3). Remove snap ring (12), thrust washer (11), clutch hub (10), then place the clutch cup gear (1) with gear up on the bench. Apply air pressure in the port hole of the clutch cup gear to remove piston (2).

With unit disassembled, clean and inspect all parts and renew any showing excessive wear or other damage. Pay particular attention to the clutch discs which should be free of scoring or warpage. Use all new "O" rings, seals and gaskets during reassembly. The bushing (2 – Fig. 166) for the 1000 rpm output shaft or lower drive shaft is in the front of differential compartment. This bushing should be renewed if a new output shaft is required or if the sealing rings have grooved the bushing. When installing bushing (2), bottom it in bore. Position the needle bearing to within 1/16-inch plus or minus 1/32-inch of the front face of bushing as shown in Fig. 166.

Reassembly is the reverse of disassembly. After unit is reassembled and before installing in tractor, operation of the clutch piston can be checked by using air pressure in the oil port of the clutch cup gear. This will make sure that the sealing rings on the piston were not cut when installed.

To remove the 540 rpm output shaft (3 – Fig. 167), gear (2), idler shaft (5) and idler gear (6), first remove the hydraulic lift assembly as outlined in paragraph 136. Remove snap ring (1) and unbolt bearing and seal retainer (7). Withdraw output shaft assembly and remove gear (2) through top opening. Install a cap screw (8) in rear of idler shaft (5), pull idler shaft from rear frame and remove idler gear (6) from above.

Use new "O" ring (4), oil seal and gasket and reinstall by reversing the removal procedure. Refill rear frame to proper level with IH "Hy-Tran" fluid.

All Models Equipped With Side Mount

129. To remove the 1000 rpm side mount pto, drain the rear frame. Disconnect the linkage and unbolt and remove the unit. Drive out roll pin and remove idler shaft (12 – Fig. 168) and gear (13). Remove bearing retainer (1). Pull output shaft (8) with bearings.

NOTE: When shaft is removed from gear, the two detent balls (17) and spring (16) will fall out.

Remove pipe plug from housing and drive roll pin from the selector fork shaft and remove shaft. Remove gear and fork from housing. If output shaft needle bearing is to be renewed, the new bearing must be pressed in to 3-3/16 inches plus or minus 1/32-inch as shown in Fig. 169. If idler gear needle bearing is to be renewed, press in to dimension

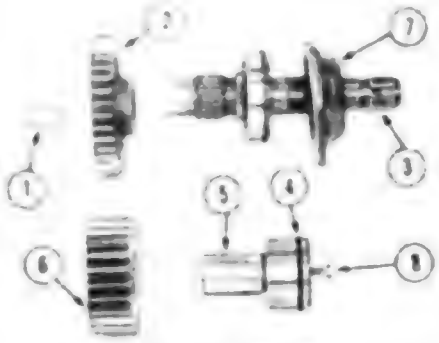

Fig. 167 – View showing the 540 rpm output shaft.

1. Snap ring
2. Output gear
3. Output shaft (540 rpm)
4. "O" ring
5. Idler shaft
6. Idler gear
7. Bearing & seal retainer
8. Cap screw

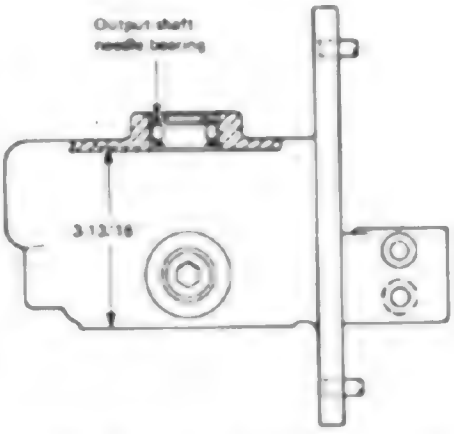

Fig. 169 – Output shaft bearing is pressed in housing to the dimensions shown.

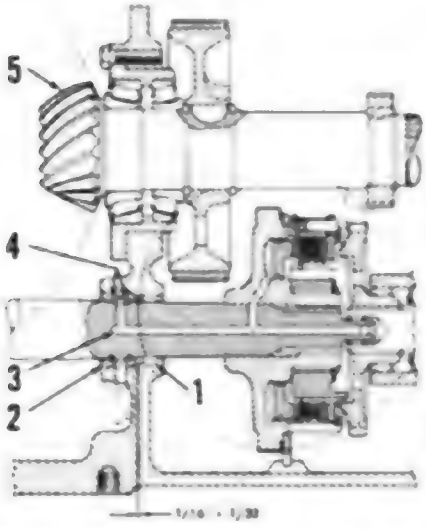

Fig. 166 – Sectional view of the pto clutch. Refer to text.

1. Needle bearing
2. Bushing
3. Pressure oil passage
4. Sealing rings
5. Piston

Fig. 168 – Exploded view of side mount 1000 rpm pto.

1. Bearing retainer
2. Gasket
3. Seal
4. Snap ring
5. Bearing
6. Snap ring
7. Gear
8. Output shaft
9. Housing
10. Needle bearing
11. Gasket
12. Idler shaft
13. Idler gear
14. Needle bearing
15. Spacer
16. Poppet spring
17. Poppet ball (2)
18. Shaft
19. "O" ring
20. Fork
21. Blocks

shown in Fig. 170.

With unit disassembled, clean and inspect all parts and renew as necessary. Use new seal and gaskets during reassembly.

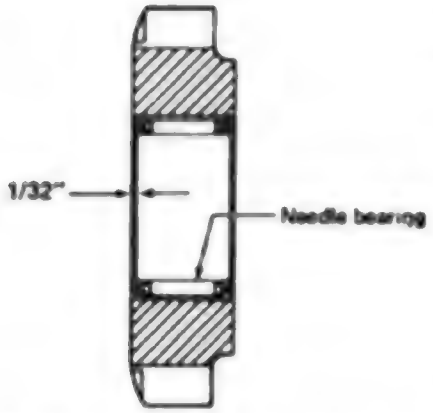

Fig. 170 – Bearing installation in idler gear of pto side mount.

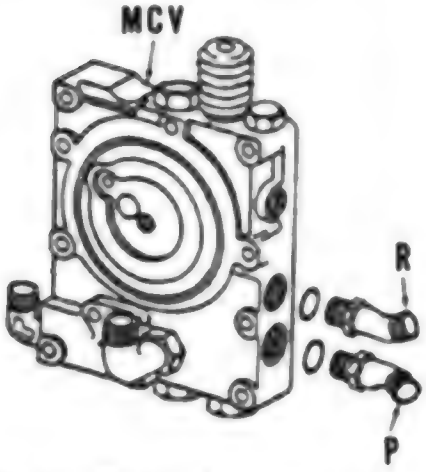

Fig. 171 – View showing pressure and return ports from MCV to the hydraulic lift.
P. Pressure port R. Return port

While reassembly is the reverse of disassembly, the following points are to be considered during reassembly. When installing output shaft, install the poppet spring and two detent balls. Hold the balls in place with a hose clamp as the shaft is pushed through the gear. Remove clamp after gear is positioned on shaft. Install the idler shaft and gear with the shoulder of gear toward the idler gear support.

HYDRAULIC LIFT SYSTEM

The hydraulic lift system provides load (draft) and position control in conjunction with the 3-point hitch.

The load (draft) control is taken from the third (upper) link and transferred through a bellcrank on the torsion bar and linkage to this draft control valve located in the hydraulic lift housing. The externally mounted torsion bar is located on the rear side of lift unit.

The hydraulic lift housing, which also serves as the cover for the differential portion of the tractor rear main frame, contains the work cylinder, rockshaft, valves and the necessary linkage. Auxiliary valves (either one or two), on tractors so equipped, are mounted on right side of the lift-housing. The pump which supplies the hydraulic system is attached to the multiple control valve (MCV) which is mounted on left side of rear frame. Pump is driven by a gear on the rear of pto driven shaft. The oil used in the hydraulic system is drawn from the rear main frame and through a full-flow filter which is a part of the MCV on left side of rear frame.

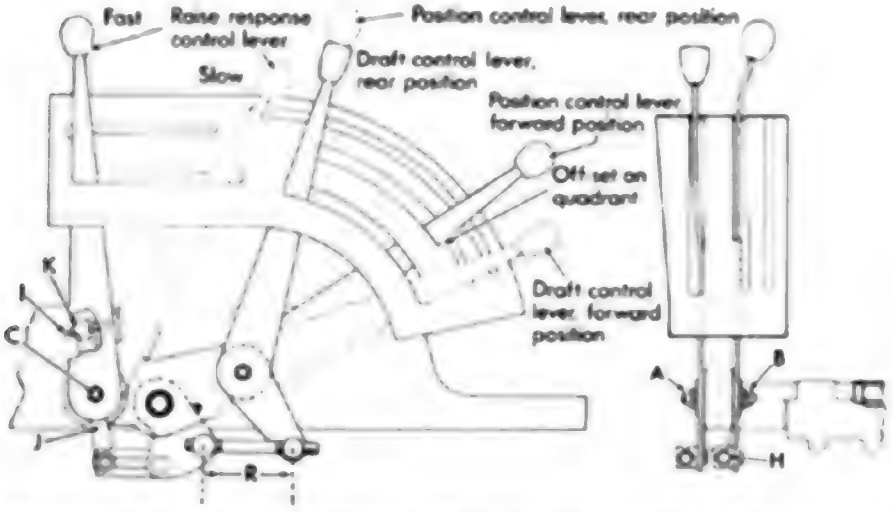

Fig. 172 – View showing adjusting points on hydraulic lift controls. Nominal setting at point (R) is: Position control 3-5/16 inches and draft control 3-13/32 inches. Refer to text.

TROUBLESHOOTING

All Models

130. The following are symptoms which may occur during operation of the hydraulic lift system. By using this information in conjunction with the Test and Adjust information, no trouble should be encountered in servicing the hydraulic lift system.

1. Hitch will not lift. Could be caused by:
   a. Faulty main relief valve.
   b. Faulty cushion relief valve.
   c. Internal linkage disconnected.
2. Hitch lifts when auxiliary valve is actuated. Could be caused by:
   a. Unloading valve orifice plugged.
   b. Unloading valve piston sticking.
   c. Unloading valve body assembly not seating or body assembly loose.
3. Hitch lifts very slowly. Could be caused by:
   a. Unloading valve leaking.
   b. Excessive load.
   c. Faulty main relief valve.
   d. Faulty cushion relief valve.
   e. Work cylinder or piston scored or "O" ring faulty.
   f. Flow control valve stuck in slow position.
   g. Inefficient pump.
4. Hitch will not lower. Could be caused by:
   a. Main control valve spool sticking or spring faulty.
   b. Drop poppet "O" ring is damaged or drop poppet is sticking.
5. Hitch lowers very slowly. Could be caused by:
   a. Action control valve spool or piston sticking.
   b. Action control valve linkage maladjusted.
   c. Drop poppet valve "O" ring damaged.
6. Hitch lowers too fast in action control zone. Could be caused by:
   a. Improper adjustment of action control valve.
7. Hitch will not maintain position. Could be caused by:
   a. Work cylinder or piston scored or piston "O" ring damaged.
   b. Cylinder cushion relief valve leaking.
   c. Drop poppet check valve ball not seated.
   d. Drop poppet ball seat binding in the drop poppet.
8. Hydraulic system stays on high pressure. Could be caused by:
   a. Linkage maladjusted, broken or disconnected.
   b. Auxiliary valve not in neutral.
   c. Mechanical interference.

9. System stays on high pressure after lifting load, but returns to low pressure after slight movement of position control lever toward "Lower" position. Could be caused by:
   a. Leak in piston side of unloading valve circuit.
10. Hitch senses with load control in "OFF" position. Could be caused by:
   a. Improper adjustment of load sensing linkage.

TEST AND ADJUST

All Models

131. Before proceeding with any testing or adjusting, be sure the hydraulic pump is operating satisfactorily, hydraulic fluid level is correct and filter is in good condition. All tests should be conducted with hydraulic fluid at operating temperature which is normally 120 to 180 degrees F. Cycle system if necessary to insure that system is completely free of air.

132. **RELIEF VALVE.** To check the hydraulic lift system relief valve, disconnect the pressure line (P – Fig. 171) and return line (R). Attach the Flo-Rater inlet hose to (P) and the outlet hose to (R). Start and run the engine at 2300 rpm on Model 684 or 2400 rpm on Models 784, 884 and Hydro 84. Restrict the Flo-Rater to 1250 psi and the pump should deliver 12.5 gpm on Model 684 or 13 gpm on Models 784, 884 and Hydro 84. Continue to restrict the Flo-Rater to 1500-1600 psi. Flow should drop approximately 2½ gpm at this point. Then, restrict the Flo-Rater to 2300 to 2500 psi. There should be no flow at this pressure. If pressure is not as stated, renew relief valve which is available only as a unit.

133. **QUADRANT LEVERS FRICTION ADJUSTMENT.** To test and adjust system, first check quadrant levers (draft, position and raise response). See Fig. 172. Move position control to forward position, then with draft control lever in rear position, it should require 4 to 6 pounds of force, applied at knob to move lever. If adjustment is necessary, adjust by turning nut (A). Now reverse the position of the levers and check the position control lever which should require 2 to 4 pounds of force to move lever. If necessary to adjust, turn nut (B). Move position control lever to forward position. Move raise response lever to fast position. Turn adjusting nut (C) until a force of 2 to 4 pounds is required to move response lever.

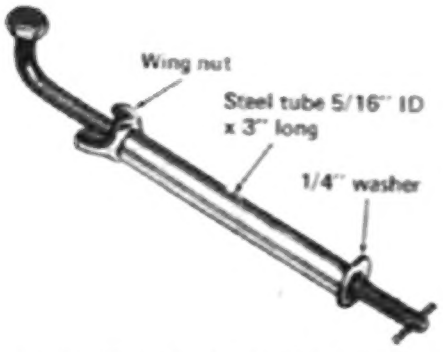

Fig. 173 – View showing locating bolt for adjusting the drop poppet valve.

134. **DROP POPPET.** To adjust the drop poppet, first place the draft control lever in full forward (Off) position. With hitch weighted, raise hitch to top of its travel with position control lever, then lower to its midpoint. The system should come off high pressure without "hiccups." If the unit does not respond properly, proceed as follows: To make the adjustment, first make a locating bolt. Refer to Fig. 173. Using a ¼-inch bolt 6 inches long, bend head at 90 degrees and thread cap screw to a length of 4½ inches. Drill hole for a 1/16-inch roll pin ¾-inch long parallel with face of bolt head approximately ⅛-inch from end. Remove linkage access cover and replace variable valve flow control tube with hose as shown in Fig. 174. With hitch weighted, cycle the hitch a few times and position the hitch so that it is approximately 6 to 10 inches off the floor. Attach the locating bolt to the main valve actuator assembly and mount the dial indicator as shown. Now move the position control lever to raise the hitch to obtain the peak movement of the valve.

This will require only about ¼ to 3/16-inch of movement of the position lever. Record the reading that was obtained on the dial indicator. Then, move the position lever down very slowly and determine the point at which the dial indicator maintains a set position. The difference between readings should be 0.019 to 0.021 inch. If reading is over 0.021 inch, turn adjusting screw in and if less than 0.019 inch, turn screw out as shown in inset Fig. 174.

Fig. 175 – View showing method of measuring hitch maximum raise.

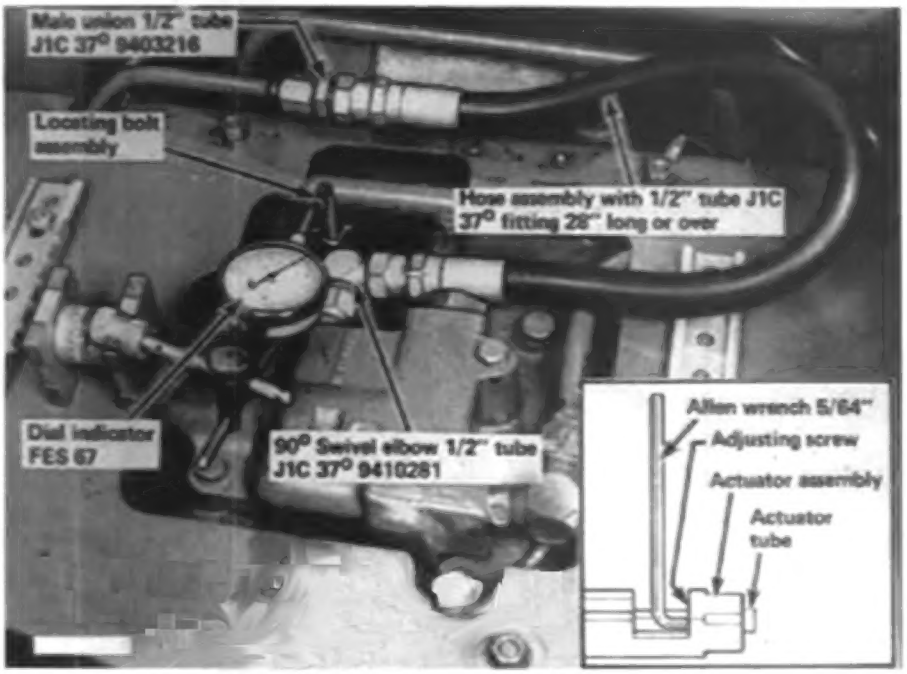

Fig. 174 – Dial indicator and locating bolt being used to adjust the drop poppet valve. Refer to text.

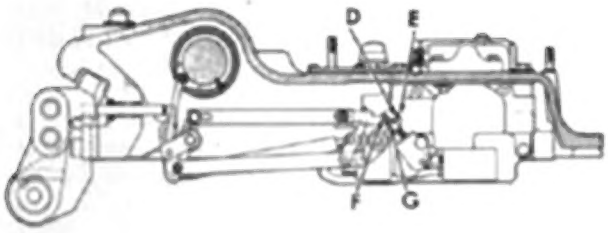

Fig. 176 – View showing linkage adjusting points. Refer to text.

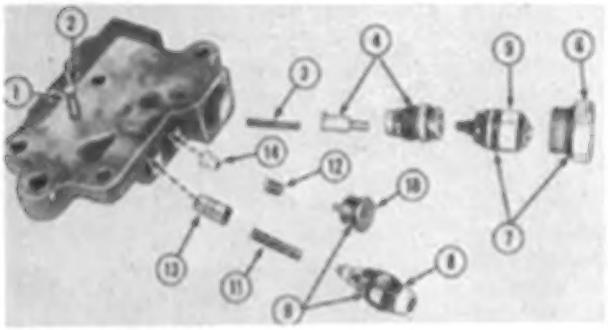

Fig. 177 – Exploded view of unloading and flow control valve.

1. "O" ring
2. Locating pin
3. Unloading valve spring
4. Unloading valve assy.
5. Unloading valve piston
6. Plug
7. "O" rings
8. Fitting
9. "O" rings
10. Plug
11. Spring
12. Spring
13. Unloading and flow control valve
14. Check poppet valve

135. **CONTROL LINKAGE.** To adjust the control linkage, start the tractor and cycle the hitch with the position control lever at least five times to free the system of air. To adjust hitch maximum raise, use a straightedge attached to torsion bar mounting face as shown in Fig. 175. Measurement at (1) should be 1-3/32 to 1-9/32 inches. If measurement is not as stated, adjust control valve spool by loosening locknut (D – Fig. 176) and turning the spool (E) in or out until rockshaft arms are within tolerance. System should not be on high pressure. Then, tighten locknut (D). Rotation of one flat of the main valve actuator tube assembly will change the measurement approximately 5/16-inch.

NOTE: If hiccupping develops, readjust drop poppet as in paragraph 134.

To adjust the drop control, move position control lever slowly forward (down) until rockshaft arms JUST reach fully lowered position. Refer to Fig. 176 and adjust screw (F) until it just contacts drop control valve arm and tighten locknut (G).

With an implement or weight attached to the hitch, move the position control lever forward (down) until it just contacts drop control valve arm. Then, adjust linkage at (H – Fig. 172) so that position control lever is at off-set on quadrant.

HYDRAULIC LIFT HOUSING

All Models

136. **REMOVE AND REINSTALL.** To remove the hydraulic lift unit from tractor, first remove the seat assembly. Disconnect wiring harness on right and left sides, fuel lines and the park brake assembly from left fender. Disconnect variable valve flow control line and remove control lever knobs. Unbolt platform from rear frame and lift off fenders, fuel tank and platform as an assembly. Disconnect and remove the draft control pressure tube and auxiliary valve return tube. Remove all other necessary hydraulic lines.

Remove the hitch lift links from rockshaft arms. Unbolt lift housing, attach hoist and lift assembly from housing.

Reinstall by reversing the removal procedure.

UNLOADING AND FLOW CONTROL VALVE

All Models

137. **R&R AND OVERHAUL.** Remove the unloading and flow control valve from top of the lift housing.

NOTE: If only the valve is to be serviced, it will not be necessary to remove lift housing.

Remove plug (6 – Fig. 177), piston (5) and unscrew valve body assembly (4). Remove plug (10), spring (12) and check poppet valve (14). Remove fitting (8), spring (11) and unloading flow control valve (13).

NOTE: Valve (13) is not serviced separately.

Remove locating pin (2). This pin is used to position the valve on housing.

Clean and inspect all parts and renew

Fig. 178 – Lift cylinder and valve assembly being removed from lift housing.

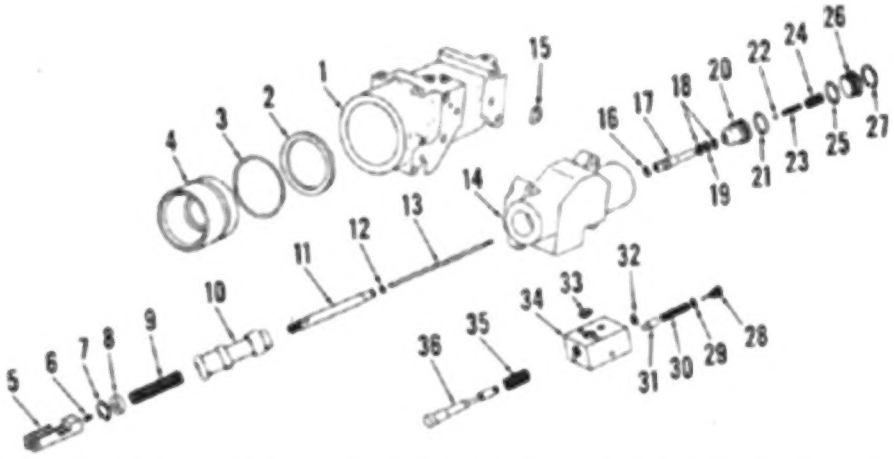

Fig. 179 – Exploded view of the lift cylinder, draft control valve and action control valve assemblies.

1. Cylinder
2. "O" ring
3. Back-up washer
4. Piston
5. Actuator link
6. Drop valve adjusting screw
7. Snap ring
8. Spring retainer
9. Spring
10. Valve spool
11. Actuator tube
12. Snap ring
13. Drop valve actuating rod
14. Draft control valve body
15. "O" ring
16. "O" ring
17. Pilot valve seat
18. Back-up washers
19. "O" ring
20. Drop poppet valve
21. "O" ring
22. Ball
23. Pilot valve spring
24. Poppet valve spring
25. "O" ring
26. Plug
27. Snap ring
28. Plug
29. "O" ring
30. Spring
31. Piston
32. "C" ring
33. "O" ring
34. Action control valve body
35. Spring
36. Variable orifice spool

any showing excessive wear or other damage. Using all new "O" rings reassemble by reversing the disassembly procedure.

CYLINDER AND VALVE UNIT

All Models

138. **R&R AND OVERHAUL.** To remove the work cylinder and valve assembly, first remove the lift unit from tractor as outlined in paragraph 136. Turn lift unit upside down on a work bench. Disconnect control linkage from main valve and other linkage. Disconnect sensing spring, then unbolt and remove cylinder and valve assembly from housing as shown in Fig. 178.

Remove the four cap screws and separate the action control valve and pipe from the draft control valve. Remove the switch lever bracket and eccentric plate assembly from cylinder housing. Remove three cap screws and retarding arm shoulder bolt, then separate draft control valve from cylinder housing.

To remove piston (4 – Fig. 179) from cylinder (1) bump open end of cylinder on a wooden block. Inspect the cylinder and piston for scoring or wear. Small defects may be removed using crocus cloth. Install new back-up ring (3) and "O" ring (2) on piston, lubricate parts with IH "Hy-Tran" fluid and reinstall piston in cylinder.

To disassemble the draft control valve, remove snap ring (7) and withdraw spool assembly from valve body (14).

NOTE: Be careful not to drop or otherwise damage the actuating rod (13).

Loosen the locknut on actuator tube (11), then count and record the number of threads, while removing actuator link (5). Remove locknut, spring retainer and spring and after first removing snap ring (12), withdraw actuator tube from spool (10).

Remove snap ring (27) and plug (26), then remove poppet valve (20) and pilot valve seat (17) with their spring and ball.

Inspect all parts for nicks, burrs, scoring and undue wear and renew as necessary. Valve body (14) and spool (10) are not available separately.

Use all new "O" rings and back-up rings, lubricate all parts with IH "Hy-Tran" fluid and reassemble parts in valve body by reversing the disassembly procedure.

To disassemble the action control valve, remove plug (28), spring (30) and pressure actuated piston (31). Hold the variable orifice spool (36) in against its spring, remove "C" ring (32), then withdraw the spool and spring from valve body. Check the pressure actuated piston and variable orifice spool and their bores in valve body for scoring or undue wear. Valve is available only as an assembly except for return spring (35) and "C" ring (32).

Lubricate all parts with IH "Hy-Tran" fluid and reassemble by reversing disassembly procedure.

After assembly, mount the draft control valve on the cylinder housing and the action control valve on the draft control valve. Tighten the cap screws. Place cylinder and valve assembly in housing and install the hold down bolts. Complete the balance of reassembly and adjust as outlined in paragraphs 133, 134 and 135.

CONTROL LEVERS, LINKAGE AND VARIABLE FLOW VALVE

All Models

139. **REMOVE AND REINSTALL.** With the hydraulic lift removed as outlined in paragraph 136 and lift cylinder removed as in paragraph 138, refer to Fig. 180 and remove the inner and outer retaining plates (2). Drive out roll pin (5), remove draft sensitivity lever (7) and spacer (4). Remove snap ring (3) and slow motion actuating lever (8).

NOTE: There are timing marks on the spline for aid in installation.

Remove control rods (1) and load control shaft (46 – Fig. 181) with bearings. Remove three cap screws holding control lever support to lift housing. Disconnect linkage from flow control arm (27) and remove position control shaft (31). Remove flow control lever (29) and friction disc (28), drive out roll pin and remove pivot bolt. Remove flow control arm (27) with return spring. Remove flow control valve plug and spool (26).

Inspect the flow control spool and housing for nicks, burrs or scoring and renew as necessary. Using new "O" rings and back-up washers, reassemble in reverse of disassembly.

To remove the control linkage, remove snap ring securing follow-up walking beam (14) and remove the walking beam with links. Remove snap rings securing position control walking link (12) to rockshaft actuating hub (9) and position control eccentric (13). Remove the right rockshaft arm and move rockshaft to the left to allow clearance for removing the position control walking link (12). Remove snap ring on outside of lift housing and remove position control eccentric (13). Draft control rod (10) and oil seal can be removed after removing draft sensing assembly (4) from housing.

Reinstall by reversing the removal procedure and adjust the system as outlined in paragraphs 133, 134 and 135.

ROCKSHAFT

All Models

140. **REMOVE AND REINSTALL.** To remove the rockshaft (2 – Fig. 181) first remove lift housing as outlined in paragraph 136 and lift cylinder and valve as in paragraph 138. Remove set screws from actuating hub (9 – Fig. 181) and rockshaft bellcrank (5). Remove the right lift arm and slide rockshaft from right to left out of housing, bellcrank and actuating hub. Remove actuating hub key as soon as it is exposed. If actuating hub sticks on rockshaft, pry against it with a heavy screwdriver so linkage will not be damaged.

Always renew the oil seals whenever rockshaft is removed. Rockshaft bushing can be removed and reinstalled using a proper sized bushing driver.

When reinstalling the rockshaft, align master splines of rockshaft and bellcrank. Position bellcrank until set screw seat in rockshaft is aligned with set screw hole in bellcrank, then install set screw.

Complete reassembly by reversing disassembly procedure.

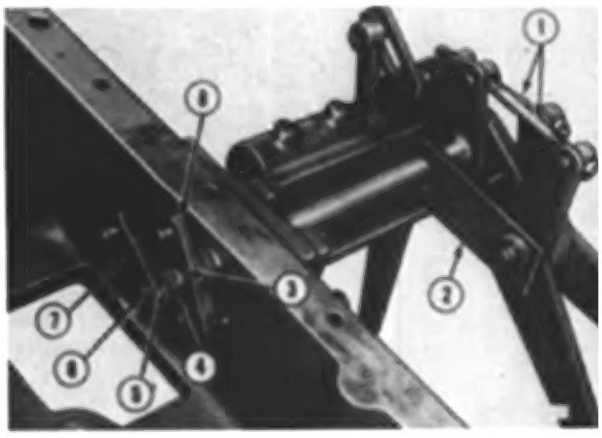

Fig. 180 – View showing control linkage and variable flow valve.

1. Connecting rod
2. Inner retaining plate
3. Snap ring
4. Spacer
5. Roll pin
6. Load control shaft
7. Draft control lever
8. Slow motion actuating lever

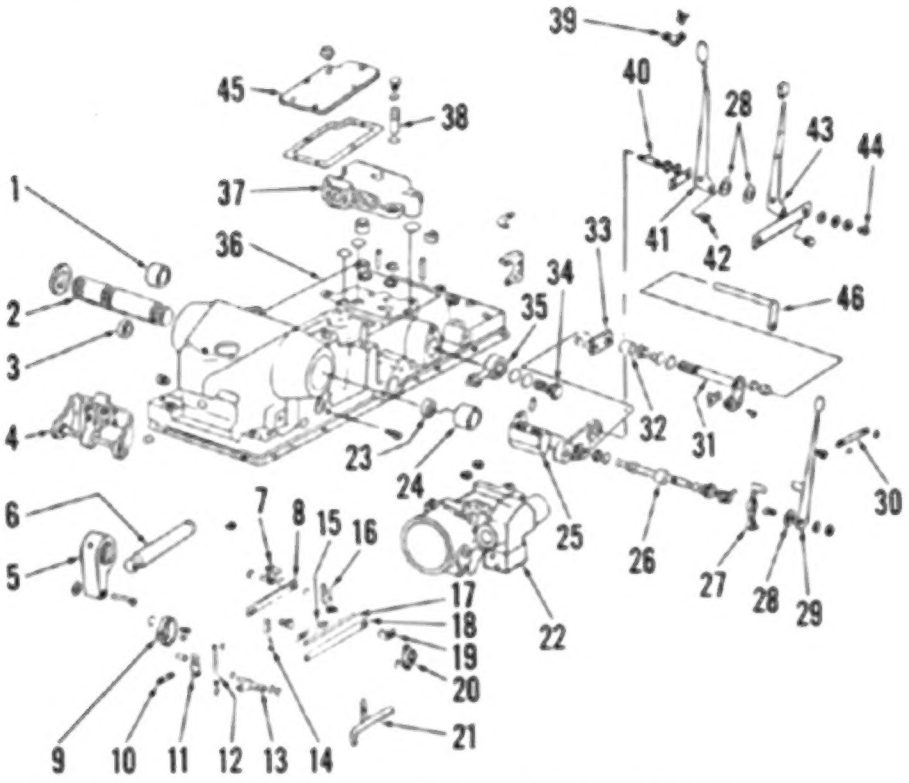

Fig. 181 – Exploded view of hydraulic lift control linkage.

1. Bushing
2. Rockshaft
3. Seal
4. Draft sensing assembly
5. Rockshaft bellcrank
6. Piston rod
7. Eccentric
8. Link
9. Actuating hub
10. Draft rod
11. Link
12. Link
13. Position control eccentric
14. Walking beam
15. Sensing spring
16. Draft control lever
17. Sensing bar
18. Walking beam bar
19. Link
20. Lever
21. Tube
22. Cylinder and valve assy
23. Seal
24. Bushing
25. Support assy
26. Variable flow spool
27. Arm
28. Friction disc
29. Flow control lever
30. Rod
31. Position control shaft
32. Spacer
33. Lever
34. Plug
35. Connector
36. Lift housing
37. Unloading and flow control valve
38. Cushion valve
39. Stop
40. Bolt
41. Position control lever
42. Pin
43. Draft control lever
44. Pin
45. Cover
46. Load control shaft

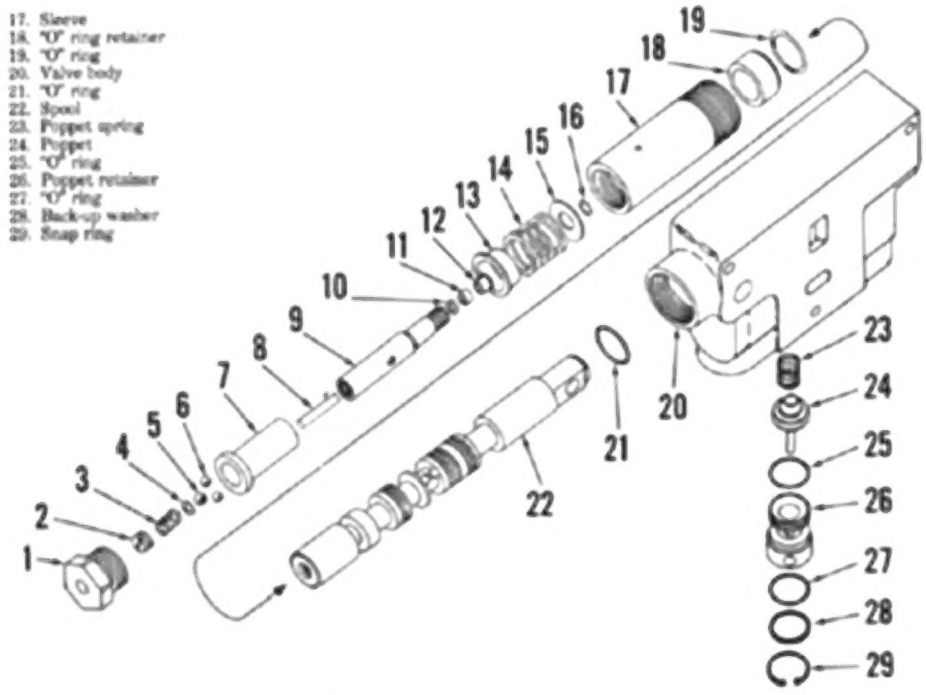

Fig. 182 – Exploded view of auxiliary control valve.

1. Cap
2. Plug
3. Detent spring
4. Washer
5. Actuating ball
6. Detent ball
7. Sleeve
8. Unlatching piston
9. Actuator
10. Back-up washer
11. "O" ring
12. Plug
13. Spring retainer
14. Centering spring
15. Washer
16. "O" ring
17. Sleeve
18. "O" ring retainer
19. "O" ring
20. Valve body
21. "O" ring
22. Spool
23. Poppet spring
24. Poppet
25. "O" ring
26. Poppet retainer
27. "O" ring
28. Back-up washer
29. Snap ring

HYDRAULIC PUMP

All Models

141. Tractors may be equipped with either Cessna or Plessey gear type pumps. For removing and reinstalling procedure, refer to paragraph 18 and for overhaul to paragraphs 19 and 20.

AUXILIARY CONTROL VALVE

All Models

142. **R&R AND OVERHAUL.** To remove the auxiliary valve or valves, unbolt and remove side panel from right console. Disconnect hydraulic lines, valve handles and remove the valves.

To disassemble, refer to Fig. 182 and proceed as follows: Remove end cap (1), then unscrew actuator (9) and remove actuator and detent assembly. Remove sleeve (17) and pull balance of parts from body. Check valve assembly can be removed at any time after removing snap ring (29). Detent (3, 4, 5 and 6) can be disassembled after removing plug (2). Push unlatching piston (8) out of actuator (9) with a long thin punch. Using a carburetor jet tool, remove actuator valve plug (12), "O" ring (11) and back-up washer (10).

Inspect all parts for nicks, burrs, scoring and undue wear and renew parts as necessary. Spool (22) and body (20) are not serviced separately.

Use all new "O" rings and reassemble by reversing the disassembly procedure. Be sure the bolt holes in the retainer (26) are lined up with bolt holes in body. When installing actuator plug (1 – Fig. 183), "O" ring (2) and back-up washer (3) should be installed to distance of 0.171-0.181 inch at (4). IH tool for installing the plug is part number FES 143-7. Detent unlatching pressure is adjusted by plug (2 – Fig. 182). Unlatching pressure is 2000-2500 psi. Be sure filter in end cap (1) is clean (no paint) and in satisfactory condition.

When reinstalling auxiliary valves, tighten the mounting cap screws to 20-25 ft.-lbs. torque in 5 ft.-lbs. increments.

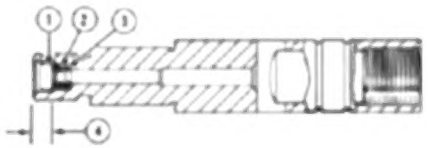

Fig. 183 – Sectional view of actuator in the auxiliary valve. Refer to text.

1. Actuator valve plug
2. "O" ring
3. Back-up washer
4. Distance for installing plug (0.171-0.181 inch)